

9.0 ENGINEERING COSTS

This chapter presents the costs estimated for compliance with the proposed effluent limitations guidelines and standards for the Landfills industry. Section 9.1 provides a discussion of the cost estimation methodologies considered by EPA including evaluation of two cost estimation models. Section 9.2 presents a discussion of the types of cost estimates developed, while in Section 9.3, the development of capital costs, operating and maintenance (O&M) costs and other related costs is described in detail. Section 9.4 summarizes the compliance costs for each regulatory option considered by EPA.

9.1 Evaluation of Cost Estimation Techniques

This section presents a discussion of the cost estimation techniques considered by EPA, including evaluation of two cost estimation models. The criteria used by EPA to evaluate these techniques as well as the results of a benchmark analysis to compare the accuracy of these techniques are presented. The selected cost estimation techniques also are presented.

9.1.1 Cost Models

Development of compliance cost estimates for leachate treatment systems is required to determine the economic impact of the regulation. EPA has identified existing cost estimation models to facilitate the development of compliance cost estimates. In a mathematical cost model, various design and vendor data on a variety of treatment technologies are combined and cost equations that describe costs as a function of system parameters, such as flow, are developed for each treatment technology. Using these types of models allows for the generation of compliance cost estimates for several regulatory options that are based on the iterative addition of treatment technologies which can assist EPA in the selection of options as the basis for the proposed regulations.

Two well known cost models were evaluated for use in developing costs:

- Computer-Assisted Procedure for the Design and Evaluation of Wastewater Treatment Systems (CAPDET), developed by the U.S. Army Corps of Engineers.
- W/W Costs Program (WWC), Version 2.0, developed by CWC Engineering Software.

CAPDET is intended to provide planning level cost estimates to analyze alternatives in the design of wastewater treatment systems. Modules are used to develop cost estimates for a variety of physical, chemical, and biological treatment unit processes and can be linked together to represent entire treatment trains. Equations in each of these modules are based upon common engineering principles used for wastewater treatment system design. The CAPDET algorithm generates a design based on input parameters selected by the user, calculates cost estimates for various treatment trains and ranks them based on present worth, capital, operating, or energy costs.

The WWC cost model was developed by Culp/Wesner/Culp from a variety of engineering sources, including vendor supplied data, actual plant construction data, unit takeoffs from actual and conceptual designs, and published data. The model calculates cost estimates for a variety of individual treatment technology units that can be combined together to develop compliance cost estimates for the complete treatment systems. The WWC model does not design each treatment technology unit but rather prompts the user to provide design input parameters that form the basis for the cost estimate. The WWC model includes a separate spreadsheet program that provides design criteria guidelines to assist in developing the input parameters to the cost estimating program. The spreadsheet includes treatment component design equations and is supplied with default parameters that are based upon accepted design criteria used in wastewater treatment, to assist in the design of particular treatment units. The spreadsheet also is flexible enough to allow selected design parameters to be modified to estimate industry-specific factors accurately. Once design inputs are entered into the program, the WWC model calculates both construction and operation and maintenance (O&M) costs for the selected wastewater treatment system.

9.1.2 Vendor Data

For certain wastewater treatment technology units, the cost model was not considered the most accurate estimate of costs. For these instances, EPA determined that actual equipment and operation and maintenance costs obtained directly from equipment vendors often can provide accurate cost estimates.

Information on landfill wastewater characteristics was provided to vendors to determine the appropriate treatment unit and accurate sizing. Quotes obtained from vendors included equipment costs that were factored up to total capital costs by the Agency to account for site preparation, mobilization costs, and engineering contingencies. Vendor quotes also were obtained for operation and maintenance costs including utility usage and cost. Vendor quotes were used to determine cost curves for equalization, multi-media filtration, and reverse osmosis. The cost curves used for these treatment technologies are based on direct vendor quotes, commercial costing guides, or cost information developed from vendor quotes as part of the Centralized Waste Treatment (CWT) effluent guidelines effort.

9.1.3 Other EPA Effluent Guideline Studies

Other EPA effluent studies, such as the Organic Chemicals and Plastics and Synthetic Fibers (OCPSF) industry effluent guidelines, were reviewed to obtain additional costing background and supportive information. However, costs developed as part of other industrial effluent guidelines are not used in costing for this industry, with the exception of the CWT effluent guideline data referenced in Section 9.1.2.

9.1.4 Benchmark Analysis and Evaluation Criteria

A benchmark analysis was performed to evaluate the accuracy of each cost estimation technique. This benchmark analysis used actual costs provided in the 308 Questionnaires and compared them to costs generated each cost estimation technique. Four landfill facilities (Questionnaire ID numbers (QIDs) 16122, 16125, 16041, and 16087) with wastewater treatment systems that were considered as a basis

for BPT/BAT/NSPS/PSES/PSNS limitations were selected by EPA for benchmarking. Cost estimates were developed for wastewater treatment units that make up the treatment systems at these landfill facilities using the WWC and CAPDET models and vendor quotes. Next, EPA compared these cost estimates to the actual component costs provided in the 308 Questionnaires to evaluate the accuracy of each methodology in estimating capital and operation and maintenance costs. This cost comparison is presented in Table 9-1. Treatment technologies that were used in this benchmark analysis include:

- equalization,
- chemical precipitation,
- activated sludge,
- sedimentation, and
- multi-media filtration.

EPA also benchmarked cost estimates developed using these techniques against actual costs for wastewater treatment systems that included equalization, chemical precipitation, and multi-media filtration, that were obtained from industrial waste combustor facilities as part of that effluent guidelines effort. EPA believes that the wastewater characteristics being treated by these treatment systems, i.e., inorganic contaminants and solids in an uncomplexed matrix, are similar for both landfills and industrial waste combustor facilities and that this additional comparison provides a more thorough evaluation of the Agency's cost estimation methodologies. Table 9-2 presents a comparison of the capital and O&M costs obtained for the wastewater treatment systems at four industrial waste combustor facilities to the cost estimates obtained using each technique, i.e., the WWC and CAPDET models, and vendor quotes.

As shown in Tables 9-1 and 9-2, EPA has determined that, based on the results of the benchmark analyses for both data sources, the WWC model generated cost estimates that are considered more accurate than the CAPDET model when compared to actual treatment technology costs as provided in 308 Questionnaire responses. In all instances, the WWC model estimated the more accurate treatment system capital and O&M costs as compared to CAPDET and vendor costs. For several facilities, such as QIDs 16087, 16122, and 16125, the WWC model generated capital costs to within

approximately 32 percent of costs provided in the questionnaires. O&M costs for several facilities, including QIDs 16041, 16087, and 16122, were estimated to within approximately 18 percent of costs provided in the 308 Questionnaires.

EPA used the following criteria to evaluate each cost estimation technique and to select the appropriate option for developing a methodology for estimating compliance costs for the Landfills industry:

- Does the model contain costing modules representative of the various wastewater technologies in use or planned for use in the Landfills industry?
- Can the model produce costs in the expected flow range experienced in this industry?
- Can the model be adapted to cost entire treatment trains used in the Landfills industry?
- Is sufficient documentation available regarding the assumptions and sources of data so that costs are credible and defensible?
- Is the model capable of providing detailed capital and operation and maintenance costs with unit costing breakdowns?
- Is the model capable of altering the default design criteria in order to accurately represent actual design criteria indicative of the Landfills industry?

9.1.5 Selection of Final Cost Estimation Techniques

Based upon the results of the benchmark analysis, the WWC model was selected for estimating costs for the majority of the treatment technologies that form the basis for BPT/BAT/NSPS/PSES/PSNS effluent limitations and standards. It was determined that the WWC model is capable of producing accurate capital and O&M costs for a wide range of treatment technologies. The CAPDET model was not considered capable of generating cost estimates for many of the technologies that form the basis for BPT/BAT/NSPS/PSES/PSNS effluent limitations and standards for the Landfills industry and was determined not to be as accurate in estimating technology costs for landfill facilities. Therefore, EPA decided not to use the CAPDET model for estimating compliance costs.

It was determined that the WWC model best satisfies the selection criteria. The program can estimate costs for a wide range of typical and innovative treatment technologies and can combine these costs of each technology to develop system costs. Since the WWC model is a computer based program, it readily allows for the iterative development of costs for a number of facilities and regulatory options. The program utilizes cost modules that can accommodate the range of flows and design input parameters needed to develop cost estimates for landfill facilities. Cost estimates generated by this model are based upon a number of sources, including actual construction and operation costs, as well as published data and are presented in a breakdown summary table that contains unit costs and totals. Finally, the WWC model can be adapted to estimate costs based upon specified design criteria and wastewater flow rates.

EPA notes that there were particular technologies for which WWC model did not produce accurate cost estimates; these technologies included equalization, multi-media filtration, and reverse osmosis. In low flow situations, costs developed for these treatment technologies were excessively high as compared to industry provided costs in 308 Questionnaire responses. For these technologies, EPA determined that vendor quotes provided a more accurate estimate of compliance costs and would be used in the final engineering costing methodology for these technologies.

9.2 Engineering Costing Methodology

This section presents the costing methodology used to develop treatment costs for BPT, BCT, BAT, and PSES options for the Landfills industry. This section also presents a description of additional costs, such as monitoring costs, that were developed by EPA. The following discussion presents a detailed summary of the technical approach used to estimate the compliance costs for each landfill facility. Total capital and annual operation and maintenance costs were developed for each facility in EPA's database to upgrade their existing wastewater treatment system, or to install new treatment technologies, to comply with the long term averages for each proposed option. Development of the long term averages is discussed in Chapter 11 of this document and in the Statistical Support documents. Facilities were costed primarily using the WWC model and on occasion, from cost curves developed from vendor quotes. Table 9-3 presents a breakdown of the cost estimation method

used for each treatment technology. Additional costs were developed for monitoring, Resource Conservation and Recovery Act (RCRA) permit modifications, and residual disposal. Total facility compliance costs under each proposed BPT, BCT, BAT, and PSES option then were developed by adding treatment costs with these additional costs. Cost estimates for zero or alternative discharge facilities were not developed for any of the regulatory options.

9.2.1 Treatment Costing Methodology

The methodology used to develop facility-specific BPT, BCT, BAT, and PSES option compliance costs is presented graphically on the flow diagram in Figure 9-1. Facilities were costed for an entire new treatment system, whether or not they had existing treatment at the facility, if the collected flow subject to this guideline was less than 85 percent of the total facility flow rate.

For each proposed regulatory option, each landfill facility in the Detailed Technical Questionnaire database was evaluated to determine if the facility would incur costs in order to comply with the proposed regulations. EPA compared the current discharge concentrations of the facility's effluent with the long term averages from each proposed regulatory option. If the facility's current discharge concentration was less than the long term average, it was considered to be in compliance. A facility considered to be in compliance was projected to incur costs only for additional monitoring requirements. If a facility was not in compliance but had treatment unit operations in-place capable of complying with the proposed long term averages, the facility was costed for system upgrades that would bring the facility into compliance.

For facilities that did not have BPT, BCT, BAT, or PSES treatment systems or the equivalent, cost estimates were developed for the additional unit operations and/or system upgrades necessary to meet each long term average. Facilities that were already close to compliance with the long term averages only required an upgrade to achieve compliance with proposed limitations for a regulatory option. Upgrade costs were developed using the WWC model whenever possible, and included either additional equipment to be installed as part of an existing wastewater treatment system, expansion of existing equipment, or operational changes. Examples of upgrade costs include such items as new

or expanded chemical feed systems and improved or expanded aeration systems. If a facility had no treatment system (or one that could not achieve desired levels with upgrades or minor additions) cost estimates for an entire BPT, BCT, BAT, or PSES treatment system were developed for that facility.

The first step in using the WWC model was to use the design criteria guidelines spreadsheet to develop input parameters for the computer program. Actual pollutant loadings from the facility were used whenever possible. If pollutant loadings were not available for a particular parameter, the estimates of pollutant concentrations in untreated landfill wastewater were used (see Chapter 6). The facility's baseline flow rate and the regulatory option long term averages also were used in the design of the unit operation. Certain parameters such as BOD₅, TSS, and ammonia are used directly in the WWC model and the design criteria guideline spreadsheet to design the various treatment unit operations. Metals included as pollutants of interest were selected to assist in the design of chemical precipitation systems. The metals to be treated typically control the type and amount of precipitating agents, which govern the chemical feed system design. A more detailed discussion of the design parameters and costs associated with individual treatment technologies is presented in Section 9.3.

The design parameters from the design criteria spreadsheet then were input in the WWC model to generate installed capital and O&M costs. O&M costs for treatment chemicals, labor, materials, electricity, and fuel are included in the WWC model O&M costs. Treatment costs developed using the WWC model were corrected to 1992 dollars using the Engineering News Record published indexes. After the installed capital and annual O&M costs were developed for each facility, selected cost factors, as shown in Table 9-4, were applied to the results to develop total capital and O&M costs.

To complete the estimation of compliance costs for each regulatory option, cost estimates for other than treatment component costs were developed. The assessment must take into account other costs associated with compliance with the proposed effluent limitations guidelines and standards including:

- land,
- residual disposal,

- RCRA permit modifications, and
- monitoring.

Each of these additional costs are further discussed and defined in the following sections.

Final capital costs were developed for each facility, then amortized using a seven percent interest rate over 15 years. This annualized capital cost then was added to the annual O&M cost to develop a total annual cost for each regulatory option.

9.2.1.1 Retrofit Costs

A retrofit cost factor was applied when additional equipment or processes were required for existing systems. Retrofit costs cover the need for system modifications and components, such as piping, valves, controls, etc., that are necessary to connect new treatment units and processes to an existing treatment facility. Retrofit costs were estimated at 20 percent of the installed capital cost of the equipment.

9.2.2 Land Costs

Land costs were not included in this analysis because EPA has determined that landfills have adequate land to accommodate additional treatment systems. Typically, the size of the required treatment system is small when compared to the land areas occupied by landfills. Landfills, as required by regulation and permit, have buffer zones around the fill areas. New treatment systems, or upgrades to an existing system, can be installed readily in this buffer zone or elsewhere at the landfill without the need to acquire new land.

9.2.3 Residual Disposal Costs

For each of the proposed treatment system additions or upgrades, a cost for residual disposal also was estimated. Two approaches were used: the first addressed facilities with current sludge handling capabilities, and the second addressed facilities without current sludge handling capabilities. Residual disposal costs were prepared on an annualized basis and added to the total O&M costs.

For facilities with sludge handling capabilities, the present solids treatment/dewatering system was evaluated to determine if it was capable of handling the additional sludge expected to be produced under a particular regulatory option. For facilities with insufficient capacity to handle the additional solids loadings, upgrade costs for sludge conditioning and dewatering were developed to account for the additional solids. For facilities with sufficient solids treatment capability, no additional sludge treatment costs were provided. For facilities without installed sludge conditioning and dewatering facilities, cost estimates for a sludge conditioning and dewatering system were developed.

Dewatered sludge is assumed to be disposed of on-site in the landfill. EPA's cost estimate also includes the costs associated with the handling and transportation of the sludge to the on-site landfill.

9.2.4 Permit Modification Costs

A cost associated with the modification of an existing RCRA Part B permit was included for all hazardous waste facilities requiring an upgrade or additional treatment processes. Legal, administrative, public relations, and engineering fees are included in this cost. This cost was added to the installed capital for the new or modified equipment and ranged from \$50,000 to \$250,000, based upon \$50,000 for each piece of new or modified equipment.

9.2.5 Monitoring Costs

Costs were developed for the monitoring of treatment system effluent. Costs were developed for both direct and indirect dischargers and were based upon the following assumptions:

- Monitoring costs are based on the number of outfalls through which leachate/groundwater is discharged. The costs associated with a single outfall is multiplied by the total number of outfalls to arrive at the total cost for a facility. Monitoring costs estimated by EPA are incremental to the costs already incurred by the facility.
- The capital costs for flow monitoring equipment are included in EPA's estimates.

- Sample collection costs (equipment and labor) and sample shipment costs are not included in EPA's estimates because EPA assumes that the facility is already conducting these activities as part of its current permit requirements.

Based upon a review of current monitoring practices at landfills, many conventional and nonconventional parameters, as well as several metals, are already being monitored on a routine basis. EPA developed monitoring costs based upon BOD₅ and TSS monitoring 20 times per month and weekly monitoring of ammonia and other toxic and nonconventional pollutants. In general, these frequencies are higher than currently required. Table 9-5 presents the monitoring cost per sample for the landfill facilities.

9.2.6 Off-Site Disposal Costs

EPA evaluated whether it would be more cost effective for small flow facilities to have their landfill wastewater hauled off site and treated at a centralized waste treatment facility, as opposed to on-site treatment. Total annual costs for new or upgraded wastewater treatment facilities were compared to the costs for off-site treatment at a centralized waste treatment facility. Off-site disposal costs were estimated at \$0.25 per gallon of wastewater treated. Transportation costs were added to the off-site treatment costs at a rate of \$3.00 per loaded mile using an average distance of 250 miles to the treatment facility. Transportation costs were based upon the use of a 5,000-gallon tanker truck load. Facilities that treat their wastewaters off site are considered zero or alternative dischargers and hence do not incur ancillary costs such as residual disposal, monitoring and permit modifications. EPA then used the lower of the two costs either on-site or off-site treatment. Table 9-6 presents the facilities that were costed using off-site treatment.

9.3 Development of Cost Estimates for Individual Treatment Technologies

In Chapter 8, EPA identified and described the wastewater control and treatment technologies used in the Landfills industry and how they were assembled into proposed regulatory options. The following sections describe how EPA developed cost estimates for each of the treatment technologies used in the proposed regulatory options. Specific assumptions regarding the equipment used, flow

ranges, input and design parameters, design and cost calculations are discussed for each treatment technology. Table 9-3, previously referenced, presented the method used to estimate costs for each of treatment technologies used in the proposed BPT, BCT, BAT, and PSES options. Table 9-7 presents a summary of the cost estimation techniques used to estimate costs for each treatment technology for the BPT, BCT, BAT, and PSES regulatory options, including the WWC treatment module numbers.

To facilitate the costing of many facilities, capital and O&M cost curves were developed for specific technologies and system components. These curves, which represent cost as a function of flow rate or other system design parameters, were developed using a commercial statistical software package (Slidewrite Plus Version 2.1). First, costs were developed using the WWC model for each technology or component using as a design basis, five different flow rates or other system design parameters (depending upon the governing design parameter). For instance, a technology costed on the basis of flow would have costs estimated using the WWC model at 0.01 million gallons per day (MGD), 0.05 MGD, 0.1 MGD, 0.5 MGD, and 1.0 MGD. Ranges for the five selected points were based upon a review of the flow or technology design parameters for landfill facilities and were selected to bracket the range from low to high. Next, these five data points (flow/design parameter and associated cost) were entered into a commercial statistical software program. Cost curves to model the total capital and O&M costs then were developed by the program using curve fitting routines. A second order natural log equation format was used to develop all curves. All cost curves yielded total capital and O&M costs, unless otherwise noted.

9.3.1 Equalization

EPA conducted a review of questionnaire responses to determine the typical hydraulic detention time for equalization. Based upon review of industry furnished data, a detention time of 48 hours was selected.

Equalization costs developed for each regulatory option are based on published price quotes for storage tanks. These costs were taken from the 1996 Environmental Restoration Unit Cost Book

published by R.S. Means, Inc. A cost curve as a function of flow was developed from these tank quotes. Construction costs were based upon published data for an above ground circular steel tank. Additional costs associated with a wastewater pumping system and diffused aeration to provide sufficient mixing of tank contents to prohibit settling also were included. The capital cost curve developed for equalization is presented as Equation 9-1 and is graphically presented in Figure 9-2.

Capital Costs

$$\ln(Y) = 15.177382 + 1.981547\ln(X) + 0.15768\ln(X)^2 \quad (9-1)$$

where:

X = Flow Rate (MGD), and

Y = Capital Cost (1992 \$)

The O&M cost for the equation was taken as a function of the capital cost and is based upon 10 percent of the total capital cost per year.

9.3.2 Flocculation

A cost curve was developed for flocculation using the WWC model. WWC unit process 72 was used. Costs for flocculation were a function of flow at a hydraulic detention time of 20 minutes. The capital and O&M cost curves developed for flocculation are presented as Equations 9-2 and 9-3:

Capital Costs

$$\ln(Y) = 11.744579 + 0.633178\ln(X) - 0.015585\ln(X)^2 \quad (9-2)$$

O&M Costs

$$\ln(Y) = 8.817304 + 0.533382\ln(X) + 0.002427\ln(X)^2 \quad (9-3)$$

where:

X = Flow Rate (MGD), and

$$Y = \text{Cost (1992 \$)}$$

Figures 9-3 and 9-4 graphically present the flocculation capital and O&M cost curves, respectively.

Cost estimates for flocculation basins are based on rectangular-shaped, reinforced concrete structures with a depth of 12 feet and length-to-width ratio of 4:1. Common wall construction was used where the total basin volume exceeded 12,500 cubic feet. Vertical turbine flocculators have higher structural costs than horizontal paddle flocculators because they require structural support above the basin. Horizontal paddles are less expensive and more efficient for use in larger basins, particularly when tapered flocculation is practiced. Manufactured equipment costs are based on a G value 80 (G is the mean temporal velocity gradient that describes the degree of mixing; i.e., the greater the value of G the greater the degree of mixing). Cost estimates for drive units are based on variable speed drives for maximum flexibility, and although common drives for two or more parallel basins are often utilized, the costs are based on individual drives for each basin.

Energy requirements are based on a G value 80 and an overall motor/mechanism efficiency of 60 percent. Labor requirements are based on routine operation and maintenance of 15 minutes/day/basin (maximum basin volume 12,500 cubic ft.) and a 4 hour oil change every 6 months.

9.3.3 Chemical Feed Systems

The following section presents the methodology used to calculate the chemical addition feed rates used with each applicable regulatory option. Table 9-8 is a breakdown of the design process used for each type of chemical feed. Chemical costs were taken from the September 1992 Chemical Marketing Reporter and are presented in Table 9-9.

For facilities with existing chemical precipitation systems, an evaluation was made to determine if the system was achieving the regulatory option long term averages. If the existing system was achieving long term averages, no additional chemical costs were necessary. However, if the facility was not achieving the long term averages for an option, costs were estimated for an upgrade to the chemical

precipitation system. First, the stoichiometric requirements were determined to remove each metal pollutant of interest to the long term average level. If the current feed rates were within the calculated feed rates, no additional costs were calculated. For facilities currently feeding less than the calculated amounts, costs were estimated for an upgrade to add additional precipitation chemicals, such as a coagulant, or expand their existing chemical feed system to accommodate larger dosage rates.

Facilities without an installed chemical precipitation system were costed for an entire metals precipitation system. The chemical feed rates used at a particular facility for either an upgrade or a new system were based upon stoichiometric requirements, pH adjustments, and the buffering ability of the raw influent.

In the CWT industry guideline, it was determined that the stoichiometric requirements for chemical addition far outweighed the pH and buffer requirements. EPA determined that 150 percent of the stoichiometric requirement would sufficiently account for pH adjustment and buffering of the solution. An additional 50 percent of the stoichiometric requirement was included to react with metals not on the pollutant of interest list. Finally, an additional 10 percent was added as excess.

Sodium Hydroxide Feed Systems

The stoichiometric requirement for either lime or hydroxide to remove a particular metal is based upon the generic equation:

$$lb_{treatment\ chemical} = \left(\frac{lb_{M\ removed}}{year} \right) \left(\frac{valence_M}{MW_M} \right) \left(\frac{MW_{treatment\ chemical}}{valence_{Na/Ca}} \right)$$

where, M is the target metal and MW is the molecular weight.

The calculated amounts of sodium hydroxide to remove a pound of each of the selected metal pollutants of concern are presented in Table 9-10.

Sodium hydroxide chemical feed system costs were developed for many facilities using the WWC model. Actual facility loadings were used to establish the sodium hydroxide dosage requirement. WWC unit process 45 was used to develop capital and O&M costs for sodium hydroxide feed systems. The capital and O&M cost curves developed for sodium hydroxide feed systems based upon the calculated dosage are presented as Equations 9-4 and 9-5, respectively.

Capital Costs

$$\ln(Y) = 10.653 - 0.184\ln(X) + 0.040\ln(X)^2 \quad (9-4)$$

O&M Costs

$$\ln(Y) = 8.508 - 0.0464\ln(X) + 0.014\ln(X)^2 \quad (9-5)$$

where:

X = Dosage Rate (lb/day), and

Y = Cost (1992 \$)

Figures 9-5 and 9-6 graphically present the sodium hydroxide feed system capital and O&M cost curves, respectively.

Cost estimates for a sodium hydroxide feed system estimated using WWC unit process 45 are based on a sodium hydroxide feed rate of between 10 to 10,000 lb/day, with dry sodium hydroxide used at rates less than 200 lb/day, and liquid sodium hydroxide used at higher feed rates.

The WWC model assumes that dry sodium hydroxide (98.9 percent pure) is delivered in drums and mixed to a 10 percent solution on site. A volumetric feeder is used to feed sodium hydroxide to one of two tanks; one for mixing the 10 percent solution, and one for feeding. Two tanks are necessary for this process because of the slow rate of sodium hydroxide addition due to the high heat of solution. Each tank is equipped with a mixer and a dual-head metering pump, used to convey the 10 percent solution to the point of application. Pipe and valving is required to convey water to the dry

sodium hydroxide solution mixing tanks and between the metering pumps and the point of application.

A 50 percent sodium hydroxide solution is purchased premixed and delivered by bulk transport for feed rates greater than 200 lb/day. The 50 percent solution contains 6.38 pounds of sodium hydroxide per gallon, that is stored for 15 days in fiberglass reinforced polyester (FRP) tanks. Dual-head metering pumps are used to convey the liquid solution to the point of application, and a standby metering pump is provided in all systems. The storage tanks are located indoors, since 50 percent sodium hydroxide begins to crystallize at temperatures less than 54°F.

Phosphoric Acid Feed Systems

In the Subtitle C Hazardous subcategory, phosphoric acid is necessary to neutralize the waste stream and to provide phosphorus to biological treatment systems.

The phosphoric acid feed system was costed using the WWC unit process 46. The amount of phosphoric acid necessary to provide nutrient phosphorus was determined to be the controlling factor over the amount required for pH adjustment. A ratio of BOD₅ removed to the amount of phosphorus present in the influent waste stream (100 pounds BOD₅ removed to one pound phosphorus) was used to determine the amount of phosphoric acid to be added as a nutrient feed to biological treatment system. To allow for solution buffering, 10 percent excess phosphoric acid was added. The capital and O&M cost curves developed for phosphoric acid feed systems based upon the calculated dosage are presented as Equations 9-6 and 9-7, respectively.

Capital Costs

$$\ln(Y) = 10.042 - 0.155\ln(X) + 0.049\ln(X)^2 \quad (9-6)$$

O&M Costs

$$\ln(Y) = 7.772 - 0.086\ln(X) + 0.041\ln(X)^2 \quad (9-7)$$

where:

X = Dosage Rate (gpd), and

Y = Cost (1992 \$)

Figures 9-7 and 9-8 graphically present the phosphoric acid feed system capital and O&M cost curves, respectively.

Costs are based on systems capable of metering 93 percent concentrated acid from a storage tank directly to the point of application. For feed rates up to 200 gpd, the concentrated acid is delivered in drums and stored indoors. At higher flow rates, the acid is delivered in bulk and stored outdoors in FRP tanks. Phosphoric acid is stored for 15 days, and a standby metering pump is included for all installations.

Polymer Feed Systems

WWC unit process 34 was used to cost for polymer feed systems based upon a dosage rate of 2 mg/l. Although this module estimates costs for a liquid alum feed system, costs generated by this module were determined to be more reasonable and accurate in developing polymer system costs than the WWC unit process 43 for polymer feed systems. The capital and O&M unloaded cost curves developed for polymer feed systems are presented as Equations 9-8 and 9-9, respectively.

Capital Costs

$$\ln(Y) = 10.539595 - 0.13771\ln(X) + 0.052403\ln(X)^2 \quad (9-8)$$

O&M Costs

$$\ln(Y) = 9.900596 + 0.99703\ln(X) + 0.00019\ln(X)^2 \quad (9-9)$$

where:

X = Dosage Rate (lb/hr), and

Y = Cost (1992 \$)

Figures 9-9 and 9-10 graphically present the polymer feed system capital and O&M cost curves, respectively.

Polymer is stored for 15 days in fiberglass reinforced polyester tanks. For smaller installations, the tanks are located indoors and left uncovered and for larger installations, the tanks are covered and vented, with insulation and heating provided. Dual-head metering pumps deliver the polymer from the storage tank and meters the flow to the point of application. Feed costs include 150 feet of 316 stainless steel pipe, along with fittings and valves for each metering pump. A standby metering pump is included for each installation.

9.3.4 Primary Clarification

Cost curves were developed for primary clarification using the WWC model. WWC unit process 118 for a rectangular basin with a 12 foot side wall depth was used. Costs for primary clarification were based upon a function of flow at an overflow rate of 900 gallons per day per square feet tank size. The capital and O&M cost curves developed for primary clarification are presented as Equations 9-10 and 9-11, respectively.

Capital Costs

$$\ln(Y) = 12.517967 + 0.575652\ln(X) + 0.009396\ln(X)^2 \quad (9-10)$$

O&M Costs

$$\ln(Y) = 10.011664 + 0.268272\ln(X) + 0.00241\ln(X)^2 \quad (9-11)$$

where:

X = Flow Rate (MGD), and

Y = Cost (1992 \$)

Figures 9-11 and 9-12 graphically present the primary clarification capital and O&M cost curves, respectively.

Estimated costs are based on rectangular basins with a 12 feet side water depth (SWD) and chain and flight sludge collectors. Costs for the structure assumed multiple units with common wall construction and include the chain and flight collector, collector drive mechanism, weirs, the reinforced concrete structure complete with inlet and outlet troughs, a sludge sump, and sludge withdrawal piping. Yard piping to and from the clarifier is not included in the cost estimates.

9.3.5 Activated Sludge Biological Treatment

Costs for biological treatment systems using the activated sludge process were estimated using the WWC unit process 18 for a rectangular aeration basin with an 10 foot SWD. Basin size was determined using a 24 hour hydraulic detention time. Basin volume was calculated using Equation 9-12.

$$X = ((24 \text{ Hours} \times 3600) \times (Z))/1,000 \quad (9-12)$$

where:

X = Basin Volume (1,000 cu ft)

Z = Flow Rate (cfs)

The WWC model assumes zero O&M costs for the aeration basins only. The unloaded (without engineering cost factors applied) capital cost curve developed for aeration basins with an 10 foot SWD is presented as Equation 9-13.

$$\ln(Y) = -1.033901 + 3.722693\ln(X) - 0.197016\ln(X)^2 \quad (9-13)$$

where:

X = Basin Volume (in thousands of cubic feet), and

Y = Capital Cost (1992 \$)

Figure 9-13 graphically presents the aeration basin capital cost curve.

Aeration using diffused air was costed for the basin using WWC unit process 26 and actual facility loading conditions. Aeration requirements were calculated using the facility BOD₅ and ammonia loadings and was determined using Equation 9-14.

$$X = ((A + B)/0.075 \times C \times 0.232 \times 1440)/1,000 \quad (9-14)$$

where:

X = Air Requirement (1,000 standard cubic feet per minute [scfm])

A = BOD₅ to Aeration Basin (lb/day) based on 1.8 lb O₂/lb BOD₅ influent

B = Ammonia to Aeration Basin (lb/day) based on 4.6 lb O₂/lb ammonia influent

C = Transfer Efficiency at 9 percent

The unloaded capital and O&M cost curves developed for air diffusion systems are presented as Equations 9-15 and 9-16, respectively.

Capital Costs

$$\ln(Y) = 11.034417 + 0.992985\ln(X) - 0.002521\ln(X)^2 \quad (9-15)$$

O&M Costs

$$\ln(Y) = 9.497546 + 0.549715\ln(X) - 0.004216\ln(X)^2 \quad (9-16)$$

where:

X = Air Requirement (1,000 scfm), and

Y = Cost (1992 \$)

Figures 9-14 and 9-15 graphically present the air diffusion system capital and O&M cost curves, respectively.

The costs for aeration basins include all equipment, piping, electrical, and labor for installation. The air supply system costs include piping from air source to aeration basin, blowers, controls, and housing. Aeration basin cost estimates include excavation, concrete walkways, in-basin process piping, and handrails and attendant costs, but excludes the cost of aeration equipment, electrical and instrumentation work. EPA considered providing for heated aeration basins for facilities located in cold weather climates. Based upon data collected by EPA, biological treatment of landfill generated wastewater was not adversely affected by climate conditions.

9.3.6 Secondary Clarification

Cost curves were developed for secondary clarification using the WWC model. WWC unit process 118 for a rectangular basin with a 12 foot side wall depth, and chain and flight collectors was used. Costs for secondary clarification were based upon a function of flow, at an overflow rate of 900 gallons per day per square feet tank size. The capital and O&M cost curves developed for secondary clarification are presented as Equations 9-17 and 9-18, respectively.

Capital Costs

$$\ln(Y) = 12.834601 + 0.688675\ln(X) + 0.035432\ln(X)^2 \quad (9-17)$$

O&M Costs

$$\ln(Y) = 10.197762 + 0.339952\ln(X) + 0.015822\ln(X)^2 \quad (9-18)$$

where:

X = Flow Rate (MGD), and

Y = Cost (1992 \$)

Figures 9-16 and 9-17 graphically present the secondary clarification capital and O&M cost curves, respectively.

Costs for the structure assumed multiple units with common wall construction, and include the chain and flight collector, collector drive mechanism, weirs, the reinforced concrete structure complete with inlet and outlet troughs, a sludge sump, and sludge withdrawal piping. Yard piping to and from the clarifier is not included in the cost estimates.

9.3.7 Multimedia Filtration

Cost curves as a function of flow rate were developed for a multi-media filtration system using vendor supplied quotes. The cost curves were developed as part of the CWT effluent guidelines effort. The capital and O&M cost curves developed for multi-media filtration are presented as Equations 9-19 and 9-20, respectively.

Capital Costs

$$\ln(Y) = 12.265 + 0.658\ln(X) + 0.036\ln(X)^2 \quad (9-19)$$

O&M Costs

$$\ln(Y) = 10.851 + 0.168\ln(X) + 0.018\ln(X)^2 \quad (9-20)$$

where:

X = Flow Rate (MGD), and

Y = Cost (1992 \$)

Figures 9-18 and 9-19 graphically present the multi-media filtration capital and O&M cost curves, respectively.

The total capital costs for the multi-media filtration systems represent equipment and installation costs. The total construction cost includes the costs of the filter, instrumentation and controls, pumps, piping, and installation. The operation and maintenance costs include energy usage, maintenance, labor, and taxes and insurance. Energy costs include electricity to run the pumps,

lighting, and instrumentation and controls. The labor requirement for the multi-media filtration system was four hours per day.

9.3.8 Reverse Osmosis

Capital and O&M cost curves as a function of flow rate were developed for reverse osmosis treatment using vendor supplied quotes. Costs were based on one single-pass system using disk tube module technology. The capital cost curve developed for reverse osmosis is presented as Equation 9-21.

$$\ln(Y) = 14.904 - 0.0142\ln(X) - 0.0687\ln(X)^2 \quad (9-21)$$

where:

X = Flow Rate (MGD), and

Y = Capital Cost (1992 \$)

Figure 9-20 graphically presents the reverse osmosis capital cost curves. Based upon vendor supplied costs, O&M costs were taken at \$0.02/gallon.

Costs for a standard reverse osmosis system generally include the following components: filter booster pump, sand or carbon filter, cartridge filter, high-pressure pump and control system, reverse osmosis module permeators, pure water deacidification filter, inbuilt closed circuit cleaning system, automatic pure water membrane flushing system, power and control system with microprocessor, full instrumentation and measurement equipment, comprehensive fail-safe system, fault indication, and modular skid frame construction. The costs did not take into account the following optional equipment: main raw-water supply pump, pure water tank and distribution pump, chlorine dosing system, ultra-violet disinfection system, containerized/mobile systems, self contained power supply, and anti-magnetic systems.

9.3.9 Sludge Dewatering

Costs estimated for sludge dewatering were based upon sludge drying beds. Each facility was costed separately using the WWC unit process 128. Required bed area was based upon influent characteristics at a loading of 15 gallons per day of sludge per square foot bed area. Drying bed area was calculated using Equation 9-22.

$$X = (A \times 365)/B \quad (9-22)$$

where:

X = Area (sq ft)

A = Total Dry Solids (lb/day) based on 0.8 lb solids/lb BOD₅ influent

B = 15 lb per year sludge/sq ft

The unloaded capital and O&M cost curves developed for sludge drying beds are presented as Equations 9-23 and 9-24, respectively.

Capital Costs

$$\ln(Y) = 4.488639 + 0.716471\ln(X) + 0.000005311\ln(X)^2 \quad (9-23)$$

O&M Costs

$$\ln(Y) = 6.95049 + 0.33155\ln(X) + 0.002882\ln(X)^2 \quad (9-24)$$

where:

X = Area (sq ft), and

Y = Cost (1992 \$)

Figures 9-21 and 9-22 graphically present the sludge drying bed capital and O&M cost curves, respectively.

Included in the costs are sludge distribution piping, nine inches of sand media overlying nine inches of gravel media, two foot concrete dividers between beds, and an underdrain system to remove percolating water. Land costs are excluded from the cost estimates.

Energy requirements are based on: a front-end loader to remove dried sludge from the beds and prepare the bed for the next sludge application; cleaning and preparation time of 3 hours for a 4,000 square foot bed; diesel fuel consumption of 4 gallons per hour; and 20 cleanings/bed/year.

9.4 Costs for Regulatory Options

The following sections present the costs estimated for compliance with BPT, BCT, BAT, PSES, NSPS, and PSNS effluent limitations guidelines and standards for the Subtitle D Non-Hazardous and Subtitle C Hazardous subcategories. Costs for each of the regulatory options are presented below for only the facilities in the 308 Questionnaire database, as well as, for all of the facilities in the Landfills industry based on national estimates (see Chapter 3, Section 3.2.1 for an explanation of national estimates). All costs estimates in this section are expressed in terms of 1992 dollars, unless otherwise noted.

9.4.1 BPT Regulatory Costs

Preliminary cost effectiveness analyses were developed by EPA using interim costing rounds to select proposed BPT regulatory options. The BPT costs for each subcategory are presented below.

9.4.1.1 Subtitle D Non-Hazardous Subcategory BPT Costs

Once current discharge and untreated landfill wastewater pollutant concentrations were developed for facilities in the Subtitle D Non-Hazardous subcategory, EPA evaluated two options; BPT Option I and II.

BPT Option I: Equalization and activated sludge biological treatment with sludge dewatering. For the facilities in the 308 Questionnaire database, Table 9-11 presents the total capital (\$3,201,715) and

annual O&M costs (\$927,555) for this option, as well as, the total amortized annual cost for each facility. Based on national estimates, BPT Option I for the Subtitle D Non-Hazardous subcategory is estimated to have total annualized pre-tax and post-tax costs of \$5.97 and \$5.43 million (based on 1992 dollars), respectively.

BPT Option II: Equalization, activated sludge biological treatment, and multi-media filtration with sludge dewatering. For the facilities in the 308 Questionnaire database, Table 9-12 presents the total capital (\$3,801,954) and annual O&M (\$1,197,169) costs for this option, as well as, the total amortized annual cost for each facility. Based on national estimates, BPT Option II for the Subtitle D Non-Hazardous subcategory is estimated to have total annualized pre-tax and post-tax costs of \$7.73 and \$6.85 million (based on 1992 dollars), respectively.

9.4.1.2 Subtitle C Hazardous Subcategory BPT Costs

Once current discharge and untreated landfill wastewater pollutant concentrations were developed for facilities in the Subtitle C Hazardous subcategory, EPA evaluated one BPT option; BPT Option I.

BPT Option I: Equalization, chemical precipitation, and activated sludge biological treatment with sludge dewatering. Since EPA has estimated that there are no direct discharge facilities in the Subtitle C Hazardous subcategory database, there are no costs associated with this option.

9.4.2 BCT Regulatory Costs

Preliminary cost effectiveness analyses were developed by EPA using interim costing rounds to select proposed BCT regulatory options. The BCT costs for each subcategory are presented below.

9.4.2.1 Subtitle D Non-Hazardous Subcategory BCT Costs

Once current discharge and untreated landfill wastewater pollutant concentrations were developed for facilities in the Subtitle D Non-Hazardous subcategory, EPA evaluated two options; BCT Option I and II.

BCT Option I: Equalization and activated sludge biological treatment with sludge dewatering. This option is equivalent to BPT Option I for the Non-Hazardous subcategory with costs previously provided in Section 9.4.1.1 above.

BCT Option II: Equalization, activated sludge biological treatment, and multi-media filtration with sludge dewatering. This option is equivalent to BPT Option II for the Non-Hazardous subcategory with costs previously provided in Section 9.4.1.1 above.

9.4.2.2 Subtitle C Hazardous Subcategory BCT Costs

Once current discharge and untreated landfill wastewater pollutant concentrations were developed for facilities in the Subtitle C Hazardous subcategory, EPA evaluated one option; BCT Option I.

BCT Option I: Equalization, chemical precipitation, and activated sludge biological treatment with sludge dewatering. This option is equivalent to BPT Option I for the Subtitle C Hazardous subcategory, and therefore, has no associated costs.

9.4.3 BAT Regulatory Costs

Preliminary cost effectiveness analyses were developed by EPA using interim costing rounds to select proposed BAT regulatory options. The BAT costs for each subcategory are presented below.

9.4.3.1 Subtitle D Non-Hazardous Subcategory BAT Costs

EPA costed three BAT options for the Subtitle D Non-Hazardous subcategory; BAT Options I, II and III.

BAT Option I: Equalization and activated sludge biological treatment with sludge dewatering. This option is equivalent to BPT Option I for the Non-Hazardous subcategory with costs previously provided in Section 9.4.1.1 above.

BAT Option II: Equalization, activated sludge biological treatment, and multi-media filtration with sludge dewatering. This option is equivalent to BPT Option II for the Non-Hazardous subcategory with costs previously provided in Section 9.4.1.1 above.

BAT Option III: Equalization, activated sludge biological treatment, multi-media filtration, and reverse osmosis with sludge dewatering. For facilities in the 308 Questionnaire database, Table 9-13 presents the total capital (\$38,952,560) and annual O&M (\$6,481,452) costs for this option, as well as, the total amortized annual cost for each facility. Based on national estimates, BAT Option III for the Subtitle D Non-Hazardous subcategory is estimated to have a total annualized post-tax cost of \$29.16 million (based on 1992 dollars). For comparison with other regulations for other industries, the total annualized pre-tax cost for this option is estimated at \$21.97 million (based on 1981 dollars).

9.4.3.2 Subtitle C Hazardous Subcategory BAT Costs

Once current discharge and untreated landfill wastewater pollutant concentrations were developed for facilities in the Subtitle C Hazardous subcategory, EPA evaluated one BAT option; BPT Option I.

BAT Option I: Equalization, chemical precipitation, and activated sludge biological treatment with sludge dewatering. This option is equivalent to BPT Option I for the Hazardous subcategory, and therefore has no associated costs.

9.4.4 PSES Regulatory Costs

Preliminary cost effectiveness analyses were developed by EPA using interim costing rounds to select proposed PSES regulatory options. The PSES costs for each subcategory are presented below.

9.4.4.1 Subtitle D Non-Hazardous Subcategory PSES Costs

EPA estimates compliance costs for facilities in the Subtitle D Non-Hazardous subcategory for one PSES option; PSES Option I.

PSES Option I: Equalization and activated sludge biological treatment with sludge dewatering. For facilities in the 308 Questionnaire database, Table 9-14 presents the total capital (\$11,764,213) and annual O&M (\$1,957,211) costs for this option, as well as, the total amortized annual cost for each facility. Based on national estimates, the cost for this PSES option is estimated at \$28.2 million (based on 1992 dollars).

9.4.4.2 Subtitle C Hazardous Subcategory PSES Costs

For the Subtitle C Hazardous subcategory, EPA evaluated one PSES option; PSES Option I.

PSES Option I: Equalization, chemical precipitation, and activated sludge biological treatment with sludge dewatering. All of the landfills in the Hazardous subcategory which indirectly discharge their wastewaters in EPA's survey of the industry are expected to be in compliance with the baseline treatment standards established for indirect dischargers. Therefore, EPA has projected that there will be no costs associated with compliance for the proposed PSES regulation for this subcategory.

9.4.5 NSPS Regulatory Costs

Preliminary cost effectiveness analyses were developed by EPA using interim costing rounds to select proposed NSPS regulatory options. The NSPS costs for each subcategory are presented below.

9.4.5.1 Subtitle D Non-Hazardous Subcategory NSPS Costs

EPA is proposing NSPS for the Subtitle D Non-Hazardous subcategory to be equivalent to the limitations proposed for BPT Option II for this subcategory, which also is the basis for BCT, BAT, and PSES Option II.

NSPS: Equalization, activated sludge biological treatment and multi-media filtration with sludge dewatering. The total NSPS annual cost for the Non-Hazardous subcategory is \$49,600 assuming an average facility flow of 10,000 gpd.

9.4.5.2 Subtitle C Hazardous Subcategory NSPS Costs

EPA is proposing NSPS for the Subtitle C Hazardous subcategory to be equivalent to the limitations proposed for BPT Option I for this subcategory, which also is the basis for BCT, BAT, and PSES Option I.

NSPS: Equalization, chemical precipitation, and activated sludge biological treatment with sludge dewatering. The total NSPS annual cost for the Hazardous subcategory is \$152,700 assuming an average facility flow of 10,000 gpd.

9.4.6 PSNS Regulatory Costs

Preliminary cost effectiveness analyses were developed by EPA using interim costing rounds to select proposed PSNS regulatory options. The PSNS costs for each subcategory are provided below.

9.4.6.1 Subtitle D Non-Hazardous Subcategory PSNS Costs

Since EPA is not proposing PSNS standards for Subtitle D Non-Hazardous subcategory, there are no costs associated with this requirement.

9.4.6.2 Subtitle C Hazardous Subcategory PSNS Costs

EPA is proposing PSNS for the Subtitle C Hazardous subcategory to be equivalent to the limitations proposed for BPT Option I for this subcategory, which also is the basis for BCT, BAT, and PSES Option I.

PSNS: Equalization, chemical precipitation, and activated sludge biological treatment with sludge dewatering. The total PSNS annual cost for the Hazardous subcategory is \$141,400 assuming an average facility flow of 5,600 gpd.

Table 9-1: Cost Comparison

Facility QID	Treatment Train	CAPDET Computer Run		WWC Engineering Software		Vendor Quotes		Questionnaire Responses	
		Capital Cost 1992	O&M Costs	Capital Cost 1992	O&M Costs	Capital Cost 1992	O&M Costs	Capital Cost 1992	O&M Costs
16122	Chemical Precipitation	\$232,366	\$178,773	\$190,308	\$41,883	\$177,504	\$163,397	NA	\$22,858
	Above+Anaerobic&Aerobic Bio	\$1,217,370	\$353,181	\$836,433	\$79,898	\$794,343	\$305,669	NA	\$133,314
	Above+2nd Chemical Precipitation	\$1,449,732	\$587,637	\$908,201	\$91,295	\$971,847	\$469,066	NA	\$133,872
	Above+Equalization+Multimedia Filter	\$1,517,811	\$715,088	\$1,573,621	\$91,295	\$1,553,010	\$543,840	NA	\$133,872
	Equalization	\$58,478	\$69,475	\$692,252	\$1,997	\$526,532	\$36,442	NA	\$3,388
16125	Entire Treatment Train	\$1,576,289	\$784,563	\$2,782,188	\$317,747	\$2,154,117	\$586,240	\$4,113,628	\$311,400
	Equalization+Air Stripping	\$57,717	\$61,556	\$394,570	\$20,718	\$243,800	\$54,147	\$588,714	\$8,247
	Chemical Precipitation+SBR	\$282,073	\$255,294	\$1,928,245	\$103,100	(a)	(a)	\$2,067,188	\$31,534
16087	Above+Carbon+Multimedia Filter	\$478,266	\$460,622	\$2,492,431	\$145,949	(b)	(b)	\$2,534,242	\$34,883
16041	Entire Treatment Train	NA	NA	\$2,519,307	\$816,351	(c)	(c)	\$2,423,057	\$992,578
	SBR+Sludge Equipment	\$159,908	\$115,066	\$2,378,898	\$436,879	NA	NA	\$6,293,919	\$460,050

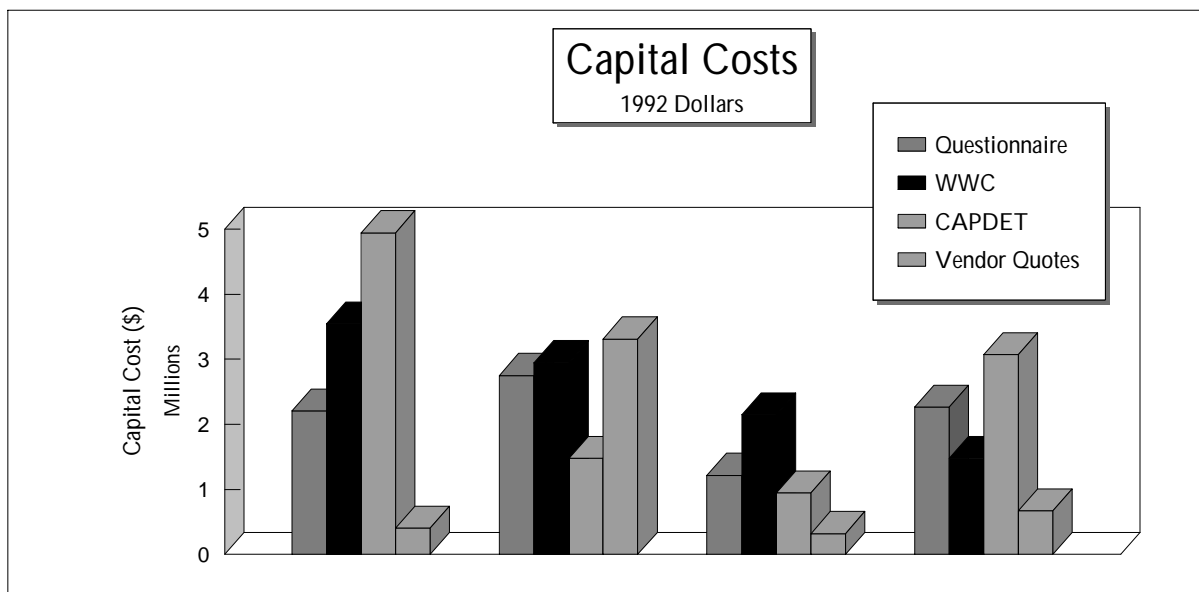
NA: Not Available

(a): capital O&M costs without the SBR are \$82,675 and \$56,972, respectively

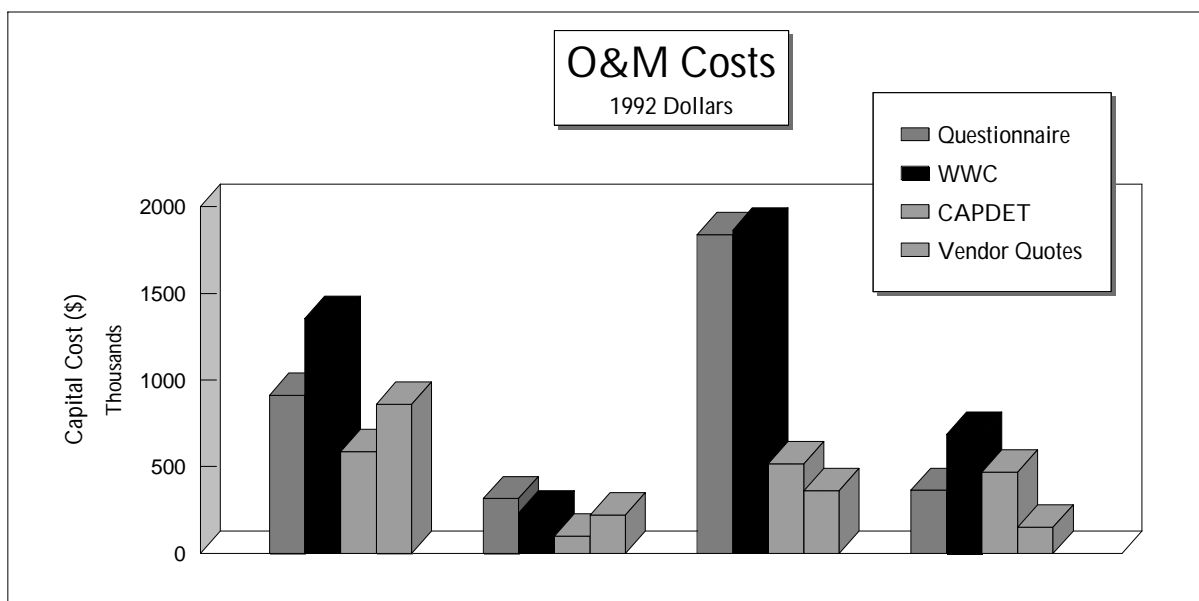
(b): capital O&M costs without the SBR are \$140,078 and \$106,642, respectively

(c): capital O&M costs without the activated sludge system and chlorine addition are \$189,120 and \$100,849, respectively

Table 9-2. Costing Source Comparison



	Chem Precip	Chem Precip and Filtration	Chem Precip	2-stage Chem Precip
Questionnaire	2,206,980	2,751,204	1,214,563	2,265,009
WWC	3,543,264	2,950,035	2,144,446	1,476,821
CAPDET	4,948,779	1,475,480	942,216	3,072,253
Vendor Quotes	399,878	3,314,930	319,206	670,158



	Chem Precip	Chem Precip and Filtration	Chem Precip	2-stage Chem Precip
Questionnaire	910,000	315,000	1,837,000	363,000
WWC	1,355,505	231,728	1,864,219	686,360
CAPDET	585,855	99,036	515,859	466,848
Vendor Quotes	860,867	222,135	361,623	151,889

Table 9-3: Breakdown of Costing Method by Treatment Technology

Treatment Technology	Cost Using WWC Program	Cost Using Vendor Quotes	Key Design Parameter(s)
Equalization		X(a)	Flow rate
Flocculation	X		Flow rate
Chemical Feed System	X		Flow rate & Pollutant of Interest Metals
Primary & Secondary Clarification	X		Flow rate
Activated Sludge	X		Flow rate, BOD ₅ , & Ammonia
Reverse Osmosis		X	Flow rate
Multimedia Filtration		X(b)	Flow rate
Sludge Drying Beds	X		Flow rate, TSS & BOD ₅

(a) Based upon costs provided in Environmental Restoration Unit Cost Book

(b) Cost curves developed using vendor quotes in the CWT guideline effort

Table 9-4: Additional Cost Factors

Type	Factor	Percent of Capital Cost
Capital	Site Work & Interface Piping	18
	General Contractor Overhead	10
	Engineering	12
	Instrumentation & Controls	13
	Buildings	6
	Site Improvements	10
	Legal, Fiscal, & Administrative	2
	Interest During Construction	9
	Contingency	8
	Retrofit (if necessary)	20
O&M	Taxes & Insurance	2 ¹

(1) 2 percent of total capital costs, which includes WWC costs and capital costs listed above.

Table 9-5: Analytical Monitoring Costs

Pollutants	Cost/Sample (\$)¹
Subtitle D Non-Hazardous	
Ammonia as N	18.00
BOD ₅	15.00
TSS	6.00
Metals & Organics	105.00
Subtitle C Hazardous	
Ammonia as N	18.00
BOD ₅	15.00
TSS	6.00
Metals & Volatile/Semi-Volatile Organics	1600.00

Notes:

(1) Cost based on 1995 analytical laboratory costs adjusted to 1992 dollars.

Table 9-6: Subtitle D Non-Hazardous Facilities Costed for Off-Site Disposal

Facility QID	Flow (gpd)	Off-Site Disposal Cost (\$/yr)
16048	5	730
16055	8	1168
16062	50	7300
16139	50	7300
16148	77	11242
16160	137	20002
16250	200	29200

Table 9-7: Unit Process Breakdown by Regulatory Option

Treatment Technology Description	Subcategory		WWC Unit Process #*	WWC Unit Process # Description
	Non-Hazardous	Hazardous		
Equalization & activated sludge	BPT/BCT/BAT/PSSES/PSNS Option I		NA	equalization
			18	aeration basin
			26	aeration system
			118	secondary clarification
Equalization, activated sludge & multimedia filtration	BPT/BCT/BAT/Option II NSPS		128	sludge dewatering
			NA	equalization
			18	aeration basin
			26	aeration system
Equalization, activated sludge, multimedia filtration & single-stage reverse osmosis	BAT Option III		118	secondary clarification
			NA	multi-media filtration
			NA	single-stage reverse osmosis
			128	sludge dewatering
Equalization, chemical precipitation & activated sludge		BPT/BCT/BAT/PSSES Option I NSPS & PSNS	NA	equalization
			18	aeration basin
			26	aeration system
			118	secondary clarification
			NA	multi-media filtration
			NA	single-stage reverse osmosis
			128	sludge dewatering
			NA	equalization
			72	flocculation tank
			45	sodium hydroxide feed system
			34	polymer feed system
			118	primary clarification
			46	phosphoric acid feed system
			18	aeration basin
			26	aeration system
			118	secondary clarification
			128	sludge dewatering

*NA=Not Applicable- Vendor Quotes Used

Table 9-8: Chemical Addition Design Method

Chemical	Basis for Design	
	Stoichiometry	Reference ¹ (mg/L)
Sodium Hydroxide	X	2.0
Polymer		
Phosphoric Acid	X	

(1) From: Industrial Water Pollution Control, 2nd Edition.

Table 9-9: Treatment Chemical Costs

Treatment Chemical	Cost
Sodium Hydroxide	\$350/ton
Polymer	\$2.25/lb
Phosphoric Acid	\$300/ton

Table 9-10: Sodium Hydroxide Requirements for Chemical Precipitation

Pollutant	Dosage Rate Sodium Hydroxide (lb/lb metal removed)
Cadmium	0.71
Chromium, total	2.31
Iron	2.15
Nickel	2.04
Zinc	1.22
Phosphorus	6.46

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16001	0.0793	153,015	2,004	31,004	0	0	186,023	20,424
16003	0.004715	0	0	0	0	0	0	0
16009	0.01613	0	0	0	0	0	0	0
16011	0	0	0	0	0	0	0	0
16012	0.002205	0	0	0	0	0	0	0
16013	0.015	0	0	0	0	0	0	0
16014	0	0	0	0	0	0	0	0
16015	0.0005	0	0	0	0	0	0	0
16016	0.002304	0	0	0	0	0	0	0
16020	0.045814	0	0	0	0	0	0	0
16023	0.057344	0	0	0	0	0	0	0
16024	0.005918	61,218	2,004	12,644	0	0	75,866	8,330
16025	0	0	0	0	0	0	0	0
16026	0	0	0	0	0	0	0	0
16027	0	0	0	0	0	0	0	0
16028	0.01985	0	0	0	0	0	0	0
16029	0.025	0	0	0	0	0	0	0
16033	0.0091	0	0	0	0	0	0	0
16035	0	0	0	0	0	0	0	0
16038	0.008219	55,167	2,004	0	0	0	57,171	6,277
16039	0.00178	0	0	0	0	0	0	0
16043	0.002177	46,342	2,004	0	0	0	48,346	5,308
16046	0	0	0	0	0	0	0	0
16047	0.001148	38,175	2,004	0	0	0	40,179	4,411
16048	5.0E-06	0	0	0	0	0	0	0
16049	0.0017	35,037	2,004	7,408	0	0	44,449	4,880
16050	0.01	58,533	2,004	0	0	0	60,537	6,647
16052	0.0546	217,678	5,563	44,648	0	0	267,889	29,413
16053	0.00124	39,625	2,004	0	0	0	41,629	4,571
16054	0.00075	16,544	2,004	3,710	0	0	22,258	2,444
16055	8.0E-06	0	0	0	0	0	0	0
16056	0.001367	40,636	2,004	0	0	0	42,640	4,682
16058	0.003	44,348	2,004	9,270	0	0	55,622	6,107
16059	0.0011	38,017	2,004	0	0	0	40,021	4,394
16060	0.0018	43,919	2,004	0	0	0	45,923	5,042

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16061	0	0	0	0	0	0	0	0
16062	0.00005	0	0	0	0	0	0	0
16063	0.0067	75,309	2,004	0	0	0	77,313	8,489
16064	0.011967	62,083	2,004	0	0	0	64,087	7,036
16065	0.008	71,448	2,004	14,690	0	0	88,143	9,678
16070	0.001328	0	0	0	0	0	0	0
16071	0.006	0	0	0	0	0	0	0
16073	0.0182	0	0	0	0	0	0	0
16074	0	0	0	0	0	0	0	0
16075	0.010209	58,917	2,004	0	0	0	60,922	6,689
16076	0	0	0	0	0	0	0	0
16077	0.00816	0	0	0	0	0	0	0
16078	0.00499	0	0	0	0	0	0	0
16079	0.112474	344,770	0	68,954	0	0	413,724	45,425
16083	0.001	29,000	2,004	6,201	0	0	37,205	4,085
16084	0.006427	0	0	0	0	0	0	0
16085	0.03	0	0	0	0	0	0	0
16088	0.03621	0	0	0	0	0	0	0
16090	0.003929	0	0	0	0	0	0	0
16091	0.232098	0	0	0	0	0	0	0
16092	0.006682	0	0	0	0	0	0	0
16093	0.081575	222,598	0	44,520	0	0	267,118	29,328
16097	0.019	0	0	0	0	0	0	0
16098	0	0	0	0	0	0	0	0
16099	0.01533	0	0	0	0	0	0	0
16102	0.01394	110,824	0	22,165	0	0	132,989	14,602
16103	0.037558	0	0	0	0	0	0	0
16107	0.001286	0	0	0	0	0	0	0
16109	0.050559	0	0	0	0	0	0	0
16111	0.0072	53,157	2,004	0	0	0	55,161	6,056
16113	0	0	0	0	0	0	0	0
16114	0.00864	0	0	0	0	0	0	0
16115	0.004071	0	0	0	0	0	0	0
16116	0.0042	0	0	0	0	0	0	0
16117	0.04	0	0	0	0	0	0	0

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16118	0.0288	0	0	0	0	0	0
16119	0.007288	0	0	0	0	0	0
16120	0.042775	0	0	0	0	0	0
16121	0.080284	0	0	0	0	0	0
16122	0.0255	0	0	0	0	0	0
16123	0.04608	206,903	8,080	42,997	0	0	28,325
16124	0.016662	129,217	14,551	0	0	0	15,785
16125	0.014193	0	0	0	0	0	0
16127	0.003627	48,545	2,004	10,110	0	0	6,660
16128	0.003963	0	0	0	0	0	0
16129	0.00469	0	0	0	0	0	0
16130	0.0003	0	0	0	0	0	0
16131	0.03	0	0	0	0	0	0
16132	0.03	0	0	0	0	0	0
16135	0.011487	0	0	0	0	0	0
16137	0	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0	0
16148	0.000077	0	0	0	0	0	0
16149	0	0	0	0	0	0	0
16150	0.045778	0	0	0	0	0	0
16151	0.002049	0	0	0	0	0	0
16152	0	0	0	0	0	0	0
16153	0.008	0	0	0	0	0	0
16154	0.010224	0	0	0	0	0	0
16155	0.00831	0	0	0	0	0	0
16156	0.173	0	0	0	0	0	0
16158	0.014275	0	0	0	0	0	0
16159	0.225	0	0	0	0	0	0
16160	0.000137	0	0	0	0	0	0
16161	0.053	0	0	0	0	0	0
16162	0.0009	0	0	0	0	0	0
16163	0	0	0	0	0	0	0
16164	0.01	0	0	0	0	0	0
16165	0.030218	0	0	0	0	0	0
16166	0.003416	0	0	0	0	0	0

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16170	0.0048	55,201	2,004	11,441	0	0	7,537
16171	0.024	0	0	0	0	0	0
16173	0.025	0	0	0	0	0	0
16174	0.0072	0	0	0	0	0	0
16175	0	0	0	0	0	0	0
16176	0.037272	0	0	0	0	0	0
16177	0	0	0	0	0	0	0
16180	0	0	0	0	0	0	0
16185	0	0	0	0	0	0	0
16186	0.00304	0	0	0	0	0	0
16187	0.003	0	0	0	0	0	0
16189	0	0	0	0	0	0	0
16191	0	0	0	0	0	0	0
16193	0.002303	0	0	0	0	0	0
16196	0.012233	108,110	11,645	0	0	0	13,148
16199	0.0008	0	0	0	0	0	0
16200	0.011416	0	0	0	0	0	0
16201	0.001881	0	0	0	0	0	0
16202	0.013007	0	0	0	0	0	0
16203	0.02	0	0	0	0	0	0
16204	0	0	0	0	0	0	0
16205	0	0	0	0	0	0	0
16206	0.057389	0	0	0	0	0	0
16208	0.003342	0	0	0	0	0	0
16211	0.15	0	0	0	0	0	0
16212	0.0007	33,574	2,004	0	0	0	3,906
16215	0	0	0	0	0	0	0
16217	0	0	0	0	0	0	0
16219	0.025438	0	0	0	0	0	0
16220	0.030405	0	0	0	0	0	0
16221	0.006616	0	0	0	0	0	0
16222	0.01548	0	0	0	0	0	0
16223	0.029041	178,211	7,768	0	0	0	20,419
16224	0	0	0	0	0	0	0
16225	0.031	0	0	0	0	0	0

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16228	0.000719	0	0	0	0	0	0
16230	0	0	0	0	0	0	0
16233	0.0097	94,269	9,868	0	0	0	11,434
16234	0.030827	0	0	0	0	0	0
16236	0.005946	0	0	0	0	0	0
16239	0	0	0	0	0	0	0
16240	0.005597	0	0	0	0	0	0
16241	0	0	0	0	0	0	0
16242	0.0005	0	0	0	0	0	0
16245	0	0	0	0	0	0	0
16246	0.001353	0	0	0	0	0	0
16248	0.01	0	0	0	0	0	0
16249	0	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0	0
16251	0.0007	0	0	0	0	0	0
16252	0.0005	0	0	0	0	0	0
16253	0.01776	0	0	0	0	0	0
TOTALS	2.694	2,770,390	101,563	329,762	0	0	351,531

(a) Amortization assuming 7% interest over 15 year period.

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory (Cont'd)

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16001	0.0793	19,637	4,078	11,540	35,255	55,679
16003	0.004715	0	0	0	0	0
16009	0.01613	0	0	0	0	0
16011	0	0	0	0	0	0
16012	0.002205	0	0	0	0	0
16013	0.015	0	0	0	0	0
16014	0	0	0	0	0	0
16015	0.0005	0	0	0	0	0
16016	0.002304	0	0	0	0	0
16020	0.045814	0	0	0	0	0
16023	0.057344	0	0	0	0	0
16024	0.005918	9,934	3,377	11,540	24,851	33,181
16025	0	0	0	0	0	0
16026	0	0	0	0	0	0
16027	0	0	0	0	0	0
16028	0.01985	0	0	0	0	0
16029	0.025	0	0	0	0	0
16033	0.0091	0	0	0	0	0
16035	0	0	0	0	0	0
16038	0.008219	11,226	1,516	9,876	22,618	28,895
16039	0.00178	0	0	0	0	0
16043	0.002177	9,333	3,173	10,500	23,006	28,314
16046	0	0	0	0	0	0
16047	0.001148	8,760	1,917	11,540	22,217	26,628
16048	5.0000E-06	0	0	0	0	730
16049	0.0017	8,302	2,208	11,540	22,050	26,930
16050	0.01	11,672	1,917	11,540	25,129	31,776
16052	0.0546	17,799	6,897	11,072	35,768	65,180

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory (Cont'd)

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16053	0.00124	9,002	1,917	11,540	22,459	27,030	
16054	0.00075	5,276	1,917	11,357	18,550	20,994	
16055	8.0000E-06	0	0	0	0	1,168	
16056	0.001367	8,921	1,917	11,540	22,378	27,060	
16058	0.003	8,936	1,917	0	10,853	16,960	
16059	0.0011	8,730	1,917	11,540	22,187	26,581	
16060	0.0018	9,178	2,208	11,540	22,926	27,968	
16061	0	0	0	0	0	0	
16062	0.00005	0	0	0	0	7,300	
16063	0.0067	11,152	3,562	11,540	26,254	34,742	
16064	0.011967	12,127	3,931	11,540	27,598	34,634	
16065	0.008	10,481	3,231	11,090	24,802	34,480	
16070	0.001328	0	0	0	0	0	
16071	0.006	0	0	0	0	0	
16073	0.0182	0	0	0	0	0	
16074	0	0	0	0	0	0	
16075	0.010209	11,672	1,516	10,500	23,688	30,377	
16076	0	0	0	0	0	0	
16077	0.00816	0	0	0	0	0	
16078	0.00499	0	0	0	0	0	
16079	0.112474	23,219	0	11,180	34,399	79,824	
16083	0.001	7,835	1,735	11,540	21,110	25,195	
16084	0.006427	0	0	0	0	0	
16085	0.03	0	0	0	0	0	
16088	0.03621	0	0	0	0	0	
16090	0.003929	0	0	0	0	0	
16091	0.232098	0	0	0	0	0	
16092	0.006682	0	0	0	0	0	

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory (Cont'd)

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16093	0.081575	30,361	0	11,180	41,541	70,869
16097	0.019	0	0	10,520	10,520	10,520
16098	0	0	0	0	0	0
16099	0.01533	0	0	0	0	0
16102	0.01394	13,163	0	11,540	24,703	39,304
16103	0.037558	0	0	0	0	0
16107	0.001286	0	0	0	0	0
16109	0.050559	0	0	0	0	0
16111	0.0072	10,980	1,516	10,500	22,996	29,052
16113	0	0	0	0	0	0
16114	0.00864	0	0	0	0	0
16115	0.004071	0	0	0	0	0
16116	0.0042	0	0	0	0	0
16117	0.04	0	0	9,908	9,908	9,908
16118	0.0288	0	0	0	0	0
16119	0.007288	0	0	11,117	11,117	11,117
16120	0.042775	0	0	9,200	9,200	9,200
16121	0.080284	0	0	0	0	0
16122	0.0255	0	0	9,948	9,948	9,948
16123	0.04608	19,430	8,365	11,540	39,335	67,660
16124	0.016662	15,985	11,381	11,540	38,906	54,691
16125	0.014193	0	0	10,712	10,712	10,712
16127	0.003627	9,190	2,756	11,540	23,486	30,146
16128	0.003963	0	0	0	0	0
16129	0.00469	0	0	11,540	11,540	11,540
16130	0.0003	0	0	11,540	11,540	11,540
16131	0.03	0	0	0	0	0
16132	0.03	0	0	0	0	0

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory (Cont'd)

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16135	0.011487	0	0	0	0	0	0
16137	0	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0	0
16148	0.000077	0	0	0	0	0	0
16149	0	0	0	0	0	0	0
16150	0.045778	0	0	0	0	0	0
16151	0.002049	0	0	0	0	0	0
16152	0	0	0	0	0	0	0
16153	0.008	0	0	0	0	0	0
16154	0.010224	0	0	0	0	0	0
16155	0.00831	0	0	0	0	0	0
16156	0.173	0	0	0	0	0	0
16158	0.014275	0	0	0	0	0	0
16159	0.225	0	0	0	0	0	0
16160	0.000137	0	0	0	0	0	0
16161	0.053	0	0	0	0	0	0
16162	0.0009	0	0	0	0	0	0
16163	0	0	0	0	0	0	0
16164	0.01	0	0	0	0	0	0
16165	0.030218	0	0	0	0	0	0
16166	0.003416	0	0	0	0	0	0
16170	0.0048	9,594	4,078	11,235	24,907	32,444	32,444
16171	0.024	0	0	0	0	0	0
16173	0.025	0	0	0	0	0	0
16174	0.0072	0	0	0	0	0	0
16175	0	0	0	0	0	0	0
16176	0.037272	0	0	0	0	0	0
16177	0	0	0	0	0	0	0

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory (Cont'd)

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16180	0	0	0	0	0	0
16185	0	0	0	0	0	0
16186	0.00304	0	0	0	0	0
16187	0.003	0	0	0	0	0
16189	0	0	0	0	0	0
16191	0	0	0	0	0	0
16193	0.002303	0	0	0	0	0
16196	0.012233	14,487	10,115	11,540	36,142	49,290
16199	0.0008	0	0	0	0	0
16200	0.011416	0	0	0	0	0
16201	0.001881	0	0	0	0	0
16202	0.013007	0	0	0	0	0
16203	0.02	0	0	0	0	0
16204	0	0	0	0	0	0
16205	0	0	0	0	0	0
16206	0.057389	0	0	0	0	0
16208	0.003342	0	0	0	0	0
16211	0.15	0	0	0	0	0
16212	0.0007	8,386	1,516	10,500	20,402	24,308
16215	0	0	0	0	0	0
16217	0	0	0	0	0	0
16219	0.025438	0	0	0	0	0
16220	0.030405	0	0	0	0	0
16221	0.006616	0	0	0	0	0
16222	0.01548	0	0	0	0	0
16223	0.029041	18,591	8,212	10,500	37,303	57,723
16224	0	0	0	0	0	0
16225	0.031	0	0	0	0	0

Table 9-11 - BPT/BCT/BAT Option I Subtitle D Non-Hazardous Subcategory (Cont'd)

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16228	0.000719	0	0	0	0	0
16230	0	0	0	0	0	0
16233	0.0097	13,366	9,277	11,540	34,183	45,617
16234	0.030827	0	0	0	0	0
16236	0.005946	0	0	0	0	0
16239	0	0	0	0	0	0
16240	0.005597	0	0	0	0	0
16241	0	0	0	0	0	0
16242	0.0005	0	0	0	0	0
16245	0	0	0	0	0	0
16246	0.001353	0	0	0	0	0
16248	0.01	0	0	0	0	0
16249	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0
16251	0.0007	0	0	0	0	0
16252	0.005	0	0	0	0	0
16253	0.01776	0	0	11,068	11,068	11,068
TOTALS	2.694	386,724	108,068	432,763	927,555	1,288,284

(b) Off-site disposal costs used for low flow facilities 16048, 16055, and 16062

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16001	0.0793	203,456	2,004	41,092	0	0	246,552	27,070
16003	0.004715	0	0	0	0	0	0	0
16009	0.01613	0	0	0	0	0	0	0
16011	0	0	0	0	0	0	0	0
16012	0.002205	0	0	0	0	0	0	0
16013	0.015	0	0	0	0	0	0	0
16014	0	0	0	0	0	0	0	0
16015	0.0005	0	0	0	0	0	0	0
16016	0.002304	0	0	0	0	0	0	0
16020	0.045814	0	0	0	0	0	0	0
16023	0.057344	0	0	0	0	0	0	0
16024	0.005918	79,930	2,004	16,387	0	0	98,321	10,795
16025	0	0	0	0	0	0	0	0
16026	0	0	0	0	0	0	0	0
16027	0	0	0	0	0	0	0	0
16028	0.01985	0	0	0	0	0	0	0
16029	0.025	0	0	0	0	0	0	0
16033	0.0091	0	0	0	0	0	0	0
16035	0	0	0	0	0	0	0	0
16038	0.008219	75,820	2,004	0	0	0	77,824	8,545
16039	0.00178	0	0	0	0	0	0	0
16043	0.002177	60,876	2,004	0	0	0	62,880	6,904
16046	0	0	0	0	0	0	0	0
16047	0.001148	51,650	2,004	0	0	0	53,654	5,891
16048	5.0000E-06	0	0	0	0	0	0	0
16049	0.0017	48,843	2,004	10,169	0	0	61,017	6,699
16050	0.01	58,533	2,004	0	0	0	60,537	6,647
16052	0.0546	217,678	5,563	44,648	0	0	267,889	29,413
16053	0.00124	39,625	2,004	0	0	0	41,629	4,571
16054	0.00075	30,019	2,004	6,405	0	0	38,427	4,219
16055	8.0000E-06	0	0	0	0	0	0	0
16056	0.001367	54,111	2,004	0	0	0	56,115	6,161
16058	0.003	44,348	2,004	9,270	0	0	55,622	6,107
16059	0.0011	51,492	2,004	0	0	0	53,496	5,874
16060	0.0018	57,885	2,004	0	0	0	59,889	6,575
16061	0	0	0	0	0	0	0	0
16062	0.00005	0	0	0	0	0	0	0
16063	0.0067	94,714	2,004	0	0	0	96,718	10,619
16064	0.011967	62,083	2,004	0	0	0	64,087	7,036

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16065	0.008	91,929	2,004	18,787	0	0	112,719	12,376
16070	0.001328	0	0	0	0	0	0	0
16071	0.006	0	0	0	0	0	0	0
16073	0.0182	0	0	0	0	0	0	0
16074	0	0	0	0	0	0	0	0
16075	0.010209	81,055	2,004	0	0	0	83,059	9,119
16076	0	0	0	0	0	0	0	0
16077	0.00816	0	0	0	0	0	0	0
16078	0.00499	0	0	0	0	0	0	0
16079	0.112474	356,066	0	71,213	0	0	427,279	46,913
16083	0.001	42,475	2,004	8,896	0	0	53,374	5,860
16084	0.006427	0	0	0	0	0	0	0
16085	0.03	0	0	0	0	0	0	0
16088	0.03621	0	0	0	0	0	0	0
16090	0.003929	0	0	0	0	0	0	0
16091	0.232098	0	0	0	0	0	0	0
16092	0.006682	0	0	0	0	0	0	0
16093	0.081575	222,598	0	44,520	0	0	267,118	29,328
16097	0.019	0	0	0	0	0	0	0
16098	0	0	0	0	0	0	0	0
16099	0.01533	0	0	0	0	0	0	0
16102	0.01394	135,429	0	27,086	0	0	162,514	17,843
16103	0.037558	0	0	0	0	0	0	0
16107	0.001286	0	0	0	0	0	0	0
16109	0.050559	0	0	0	0	0	0	0
16111	0.0072	72,986	2,004	0	0	0	74,990	8,234
16113	0	0	0	0	0	0	0	0
16114	0.00864	0	0	0	0	0	0	0
16115	0.004071	0	0	0	0	0	0	0
16116	0.0042	0	0	0	0	0	0	0
16117	0.04	37,048	0	7,410	0	0	44,458	4,881
16118	0.0288	0	0	0	0	0	0	0
16119	0.007288	0	0	0	0	0	0	0
16120	0.042775	0	0	0	0	0	0	0
16121	0.080284	0	0	0	0	0	0	0
16122	0.0255	0	0	0	0	0	0	0
16123	0.04608	246,283	8,080	50,873	0	0	305,236	33,513
16124	0.016662	155,438	14,551	0	0	0	169,989	18,664
16125	0.014193	0	0	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16127	0.003627	55,540	2,004	11,509	0	0	69,053
16128	0.003963	0	0	0	0	0	0
16129	0.00469	0	0	0	0	0	0
16130	0.0003	0	0	0	0	0	0
16131	0.03	0	0	0	0	0	0
16132	0.03	0	0	0	0	0	0
16135	0.011487	0	0	0	0	0	0
16137	0	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0	0
16148	0.000077	0	0	0	0	0	0
16149	0	0	0	0	0	0	0
16150	0.045778	0	0	0	0	0	0
16151	0.002049	0	0	0	0	0	0
16152	0	0	0	0	0	0	0
16153	0.008	0	0	0	0	0	0
16154	0.010224	0	0	0	0	0	0
16155	0.00831	0	0	0	0	0	0
16156	0.173	0	0	0	0	0	0
16158	0.014275	0	0	0	0	0	0
16159	0.225	0	0	0	0	0	0
16160	0.000137	0	0	0	0	0	0
16161	0.053	0	0	0	0	0	0
16162	0.0009	0	0	0	0	0	0
16163	0	0	0	0	0	0	0
16164	0.01	0	0	0	0	0	0
16165	0.030218	0	0	0	0	0	0
16166	0.003416	0	0	0	0	0	0
16170	0.0048	55,201	2,004	11,441	0	0	68,647
16171	0.024	0	0	0	0	0	0
16173	0.025	0	0	0	0	0	0
16174	0.0072	0	0	0	0	0	0
16175	0	0	0	0	0	0	0
16176	0.037272	0	0	0	0	0	0
16177	0	0	0	0	0	0	0
16180	0	0	0	0	0	0	0
16185	0	0	0	0	0	0	0
16186	0.00304	0	0	0	0	0	0
16187	0.003	0	0	0	0	0	0
16189	0	0	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16191	0	0	0	0	0	0	0	0
16193	0.002303	0	0	0	0	0	0	0
16196	0.012233	131,628	11,645	0	0	0	143,273	15,731
16199	0.0008	0	0	0	0	0	0	0
16200	0.011416	0	0	0	0	0	0	0
16201	0.001881	0	0	0	0	0	0	0
16202	0.013007	0	0	0	0	0	0	0
16203	0.02	0	0	0	0	0	0	0
16204	0	0	0	0	0	0	0	0
16205	0	0	0	0	0	0	0	0
16206	0.057389	0	0	0	0	0	0	0
16208	0.003342	0	0	0	0	0	0	0
16211	0.15	0	0	0	0	0	0	0
16212	0.0007	47,049	2,004	0	0	0	49,053	5,386
16215	0	0	0	0	0	0	0	0
16217	0	0	0	0	0	0	0	0
16219	0.025438	0	0	0	0	0	0	0
16220	0.030405	0	0	0	0	0	0	0
16221	0.006616	0	0	0	0	0	0	0
16222	0.01548	0	0	0	0	0	0	0
16223	0.029041	210,653	7,768	0	0	0	218,421	23,981
16224	0	0	0	0	0	0	0	0
16225	0.031	0	0	0	0	0	0	0
16228	0.000719	0	0	0	0	0	0	0
16230	0	0	0	0	0	0	0	0
16233	0.0097	116,040	9,868	0	0	0	125,908	13,824
16234	0.030827	0	0	0	0	0	0	0
16236	0.005946	0	0	0	0	0	0	0
16239	0	0	0	0	0	0	0	0
16240	0.005597	0	0	0	0	0	0	0
16241	0	0	0	0	0	0	0	0
16242	0.0005	0	0	0	0	0	0	0
16245	0	0	0	0	0	0	0	0
16246	0.001353	0	0	0	0	0	0	0
16248	0.01	0	0	0	0	0	0	0
16249	0	0	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0	0	0
16251	0.0007	0	0	0	0	0	0	0
16252	0.005	0	0	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16253	0.01776	26,840	0	5,368	0	0	32,208	3,536
TOTALS	2.694	3,315,319	101,563	385,072	0	0	3,801,954	417,434

(a) Amortization assuming 7% interest over 15 year period.

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16001	0.0793	44,857	4,078	11,540	60,475	87,545
16003	0.004715	0	0	0	0	0
16009	0.01613	0	0	0	0	0
16011	0	0	0	0	0	0
16012	0.002205	0	0	0	0	0
16013	0.015	0	0	0	0	0
16014	0	0	0	0	0	0
16015	0.0005	0	0	0	0	0
16016	0.002304	0	0	0	0	0
16020	0.045814	0	0	0	0	0
16023	0.057344	0	0	0	0	0
16024	0.005918	19,290	3,377	11,540	34,207	45,002
16025	0	0	0	0	0	0
16026	0	0	0	0	0	0
16027	0	0	0	0	0	0
16028	0.01985	0	0	0	0	0
16029	0.025	0	0	0	0	0
16033	0.0091	0	0	0	0	0
16035	0	0	0	0	0	0
16038	0.008219	21,553	1,516	9,876	32,945	41,490
16039	0.00178	0	0	0	0	0
16043	0.002177	16,600	3,173	10,500	30,273	37,177
16046	0	0	0	0	0	0
16047	0.001148	15,497	1,917	11,540	28,954	34,845
16048	5.00E-06	0	0	0	0	730
16049	0.0017	15,205	2,208	11,540	28,953	35,653
16050	0.01	11,672	1,917	11,540	25,129	31,776
16052	0.0546	17,799	6,897	11,072	35,768	65,180

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16053	0.00124	9,002	1,917	11,540	22,459	27,030
16054	0.00075	12,013	1,917	11,357	25,287	29,506
16055	8.00E-06	0	0	0	0	1,168
16056	0.001367	15,659	1,917	11,540	29,116	35,277
16058	0.003	8,936	1,917	0	10,853	16,960
16059	0.0011	15,468	1,917	11,540	28,925	34,798
16060	0.0018	16,161	2,208	11,540	29,909	36,484
16061	0	0	0	0	0	0
16062	0.00005	0	0	0	0	7,300
16063	0.0067	20,855	3,562	11,540	35,957	46,576
16064	0.011967	12,127	3,931	11,540	27,598	34,634
16065	0.008	20,721	3,231	11,090	35,042	47,418
16070	0.001328	0	0	0	0	0
16071	0.006	0	0	0	0	0
16073	0.0182	0	0	0	0	0
16074	0	0	0	0	0	0
16075	0.010209	22,741	1,516	10,500	34,757	43,877
16076	0	0	0	0	0	0
16077	0.00816	0	0	0	0	0
16078	0.00499	0	0	0	0	0
16079	0.112474	27,018	0	11,180	38,198	85,111
16083	0.001	14,573	1,735	11,540	27,848	33,708
16084	0.006427	0	0	0	0	0
16085	0.03	0	0	0	0	0
16088	0.03621	0	0	0	0	0
16090	0.003929	0	0	0	0	0
16091	0.232098	0	0	0	0	0
16092	0.006682	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16093	0.081575	30,361	0	11,180	41,541	70,869
16097	0.019	0	0	10,520	10,520	10,520
16098	0	0	0	0	0	0
16099	0.01533	0	0	0	0	0
16102	0.01394	25,465	0	11,540	37,005	54,848
16103	0.037558	0	0	0	0	0
16107	0.001286	0	0	0	0	0
16109	0.050559	0	0	0	0	0
16111	0.0072	20,895	1,516	10,500	32,911	41,144
16113	0	0	0	0	0	0
16114	0.00864	0	0	0	0	0
16115	0.004071	0	0	0	0	0
16116	0.0042	0	0	0	0	0
16117	0.04	18,524	0	9,908	28,432	33,313
16118	0.0288	0	0	0	0	0
16119	0.007288	0	0	11,117	11,117	11,117
16120	0.042775	0	0	9,200	9,200	9,200
16121	0.080284	0	0	0	0	0
16122	0.0255	0	0	9,948	9,948	9,948
16123	0.04608	39,120	8,365	11,540	59,025	92,538
16124	0.016662	29,096	11,381	11,540	52,017	70,681
16125	0.014193	0	0	10,712	10,712	10,712
16127	0.003627	11,684	2,756	11,540	25,980	33,562
16128	0.003963	0	0	0	0	0
16129	0.00469	0	0	11,540	11,540	11,540
16130	0.0003	0	0	11,540	11,540	11,540
16131	0.03	0	0	0	0	0
16132	0.03	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16135	0.011487	0	0	0	0	0	0
16137	0	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0	0
16148	0.000077	0	0	0	0	0	0
16149	0	0	0	0	0	0	0
16150	0.045778	0	0	0	0	0	0
16151	0.002049	0	0	0	0	0	0
16152	0	0	0	0	0	0	0
16153	0.008	0	0	0	0	0	0
16154	0.010224	0	0	0	0	0	0
16155	0.00831	0	0	0	0	0	0
16156	0.173	0	0	0	0	0	0
16158	0.014275	0	0	0	0	0	0
16159	0.225	0	0	0	0	0	0
16160	0.000137	0	0	0	0	0	0
16161	0.053	0	0	0	0	0	0
16162	0.0009	0	0	0	0	0	0
16163	0	0	0	0	0	0	0
16164	0.01	0	0	0	0	0	0
16165	0.030218	0	0	0	0	0	0
16166	0.003416	0	0	0	0	0	0
16170	0.0048	9,594	4,078	11,235	24,907	32,444	32,444
16171	0.024	0	0	0	0	0	0
16173	0.025	0	0	0	0	0	0
16174	0.0072	0	0	0	0	0	0
16175	0	0	0	0	0	0	0
16176	0.037272	0	0	0	0	0	0
16177	0	0	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16180	0	0	0	0	0	0	0
16185	0	0	0	0	0	0	0
16186	0.00304	0	0	0	0	0	0
16187	0.003	0	0	0	0	0	0
16189	0	0	0	0	0	0	0
16191	0	0	0	0	0	0	0
16193	0.002303	0	0	0	0	0	0
16196	0.012233	26,246	10,115	11,540	47,901	63,632	0
16199	0.0008	0	0	0	0	0	0
16200	0.011416	0	0	0	0	0	0
16201	0.001881	0	0	0	0	0	0
16202	0.013007	0	0	0	0	0	0
16203	0.02	0	0	0	0	0	0
16204	0	0	0	0	0	0	0
16205	0	0	0	0	0	0	0
16206	0.057389	0	0	0	0	0	0
16208	0.003342	0	0	0	0	0	0
16211	0.15	0	0	0	0	0	0
16212	0.0007	15,123	1,516	10,500	27,139	32,525	0
16215	0	0	0	0	0	0	0
16217	0	0	0	0	0	0	0
16219	0.025438	0	0	0	0	0	0
16220	0.030405	0	0	0	0	0	0
16221	0.006616	0	0	0	0	0	0
16222	0.01548	0	0	0	0	0	0
16223	0.029041	34,812	8,212	10,500	53,524	77,505	0
16224	0	0	0	0	0	0	0
16225	0.031	0	0	0	0	0	0

Table 9-12 - BPT/BCT/BAT Option II Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16228	0.000719	0	0	0	0	0	0
16230	0	0	0	0	0	0	0
16233	0.0097	24,252	9,277	11,540	45,069	58,893	58,893
16234	0.030827	0	0	0	0	0	0
16236	0.005946	0	0	0	0	0	0
16239	0	0	0	0	0	0	0
16240	0.005597	0	0	0	0	0	0
16241	0	0	0	0	0	0	0
16242	0.0005	0	0	0	0	0	0
16245	0	0	0	0	0	0	0
16246	0.001353	0	0	0	0	0	0
16248	0.01	0	0	0	0	0	0
16249	0	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0	0
16251	0.0007	0	0	0	0	0	0
16252	0.005	0	0	0	0	0	0
16253	0.01776	13,420	0	11,068	24,488	28,024	28,024
TOTALS	2.694	656,338	108,068	432,763	1,197,169	1,623,801	1,623,801

(b) Off-site disposal costs used for low flow facilities 16048, 16055, and 16062

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16001	0.0793	2,183,593	2,004	437,119	0	0	287,960
16003	0.004715	0	0	0	0	0	0
16009	0.01613	0	0	0	0	0	0
16011	0	0	0	0	0	0	0
16012	0.002205	0	0	0	0	0	0
16013	0.015	0	0	0	0	0	0
16014	0	0	0	0	0	0	0
16015	0.0005	0	0	0	0	0	0
16016	0.002304	0	0	0	0	0	0
16020	0.045814	0	0	0	0	0	0
16023	0.057344	0	0	0	0	0	0
16024	0.005918	603,823	2,004	121,165	0	0	79,820
16025	0	0	0	0	0	0	0
16026	0	0	0	0	0	0	0
16027	0	0	0	0	0	0	0
16028	0.01985	0	0	0	0	0	0
16029	0.025	0	0	0	0	0	0
16033	0.0091	0	0	0	0	0	0
16035	0	0	0	0	0	0	0
16038	0.008219	728,256	2,004	0	0	0	80,179
16039	0.00178	0	0	0	0	0	0
16043	0.002177	306,037	2,004	0	0	0	33,821
16046	0	0	0	0	0	0	0
16047	0.001148	191,967	2,004	0	0	0	21,297
16048	5.0000E-06	46,193	0	0	0	0	5,072
16049	0.0017	247,768	2,004	49,954	0	0	32,908
16050	0.01	797,074	2,004	0	0	0	87,734
16052	0.0546	1,949,079	5,563	390,928	0	0	257,531
16053	0.00124	190,146	2,004	0	0	0	21,097
16054	0.00075	123,852	2,004	25,171	0	0	16,582
16055	8.0000E-06	32,864	0	0	0	0	3,608
16056	0.001367	218,417	2,004	0	0	0	24,201
16058	0.003	361,815	2,004	72,764	0	0	47,934
16059	0.0011	186,408	2,004	0	0	0	20,687
16060	0.0018	266,809	2,004	0	0	0	29,514
16061	0	0	0	0	0	0	0
16062	0.00005	36,642	0	0	0	0	4,023
16063	0.0067	664,889	2,004	0	0	0	73,221
16064	0.011967	885,558	2,004	0	0	0	97,450

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16065	0.008	733,057	2,004	147,012	0	0	882,073	96,847
16070	0.001328	0	0	0	0	0	0	0
16071	0.006	0	0	0	0	0	0	0
16073	0.0182	0	0	0	0	0	0	0
16074	0	0	0	0	0	0	0	0
16075	0.010209	829,084	2,004	0	0	0	831,088	91,249
16076	0	0	0	0	0	0	0	0
16077	0.00816	0	0	0	0	0	0	0
16078	0.00499	0	0	0	0	0	0	0
16079	0.112474	2,562,809	0	512,562	0	0	3,075,371	337,659
16083	0.001	165,966	2,004	33,594	0	0	201,564	22,131
16084	0.006427	0	0	0	0	0	0	0
16085	0.03	0	0	0	0	0	0	0
16088	0.03621	0	0	0	0	0	0	0
16090	0.003929	0	0	0	0	0	0	0
16091	0.232098	0	0	0	0	0	0	0
16092	0.006682	0	0	0	0	0	0	0
16093	0.081575	2,221,423	0	444,285	0	0	2,665,708	292,680
16097	0.019	1,067,839	0	213,568	0	0	1,281,407	140,692
16098	0	0	0	0	0	0	0	0
16099	0.01533	0	0	0	0	0	0	0
16102	0.01394	1,035,581	0	207,116	0	0	1,242,698	136,442
16103	0.037558	0	0	0	0	0	0	0
16107	0.001286	0	0	0	0	0	0	0
16109	0.050559	0	0	0	0	0	0	0
16111	0.0072	671,271	2,004	0	0	0	673,275	73,922
16113	0	0	0	0	0	0	0	0
16114	0.00864	0	0	0	0	0	0	0
16115	0.004071	0	0	0	0	0	0	0
16116	0.0042	0	0	0	0	0	0	0
16117	0.04	1,562,645	0	312,529	0	0	1,875,174	205,884
16118	0.0288	0	0	0	0	0	0	0
16119	0.007288	603,122	0	120,624	0	0	723,746	79,463
16120	0.042775	1,569,551	0	313,910	0	0	1,883,461	206,794
16121	0.080284	0	0	0	0	0	0	0
16122	0.0255	1,240,783	0	248,157	0	0	1,488,939	163,478
16123	0.04608	1,864,917	8,080	374,599	0	0	2,247,596	246,774
16124	0.016662	1,150,263	14,551	0	0	0	1,164,814	127,890
16125	0.014193	909,456	0	181,891	0	0	1,091,347	119,824

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16127	0.003627	423,029	2,004	85,007	0	0	56,000
16128	0.003963	0	0	0	0	0	0
16129	0.00469	444,502	0	88,900	0	0	58,565
16130	0.0003	36,269	0	7,254	0	0	4,779
16131	0.03	0	0	0	0	0	0
16132	0.03	0	0	0	0	0	0
16135	0.011487	0	0	0	0	0	0
16137	0	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0	0
16148	0.000077	0	0	0	0	0	0
16149	0	0	0	0	0	0	0
16150	0.045778	0	0	0	0	0	0
16151	0.002049	0	0	0	0	0	0
16152	0	0	0	0	0	0	0
16153	0.008	0	0	0	0	0	0
16154	0.010224	0	0	0	0	0	0
16155	0.00831	0	0	0	0	0	0
16156	0.173	0	0	0	0	0	0
16158	0.014275	0	0	0	0	0	0
16159	0.225	0	0	0	0	0	0
16160	0.000137	0	0	0	0	0	0
16161	0.053	0	0	0	0	0	0
16162	0.0009	0	0	0	0	0	0
16163	0	0	0	0	0	0	0
16164	0.01	0	0	0	0	0	0
16165	0.030218	0	0	0	0	0	0
16166	0.003416	0	0	0	0	0	0
16170	0.0048	507,196	2,004	101,840	0	0	67,089
16171	0.024	0	0	0	0	0	0
16173	0.025	0	0	0	0	0	0
16174	0.0072	0	0	0	0	0	0
16175	0	0	0	0	0	0	0
16176	0.037272	0	0	0	0	0	0
16177	0	0	0	0	0	0	0
16180	0	0	0	0	0	0	0
16185	0	0	0	0	0	0	0
16186	0.00304	0	0	0	0	0	0
16187	0.003	0	0	0	0	0	0
16189	0	0	0	0	0	0	0

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16191	0	0	0	0	0	0	0
16193	0.002303	0	0	0	0	0	0
16196	0.012233	965,897	11,645	0	0	0	107,329
16199	0.0008	0	0	0	0	0	0
16200	0.011416	0	0	0	0	0	0
16201	0.001881	0	0	0	0	0	0
16202	0.013007	0	0	0	0	0	0
16203	0.02	0	0	0	0	0	0
16204	0	0	0	0	0	0	0
16205	0	0	0	0	0	0	0
16206	0.057389	0	0	0	0	0	0
16208	0.003342	0	0	0	0	0	0
16211	0.15	0	0	0	0	0	0
16212	0.0007	134,753	2,004	0	0	0	15,015
16215	0	0	0	0	0	0	0
16217	0	0	0	0	0	0	0
16219	0.025438	0	0	0	0	0	0
16220	0.030405	0	0	0	0	0	0
16221	0.006616	0	0	0	0	0	0
16222	0.01548	0	0	0	0	0	0
16223	0.029041	1,531,517	7,768	0	0	0	169,005
16224	0	0	0	0	0	0	0
16225	0.031	0	0	0	0	0	0
16228	0.000719	0	0	0	0	0	0
16230	0	0	0	0	0	0	0
16233	0.0097	840,751	9,868	0	0	0	93,393
16234	0.030827	0	0	0	0	0	0
16236	0.005946	0	0	0	0	0	0
16239	0	0	0	0	0	0	0
16240	0.005597	0	0	0	0	0	0
16241	0	0	0	0	0	0	0
16242	0.0005	0	0	0	0	0	0
16245	0	0	0	0	0	0	0
16246	0.001353	0	0	0	0	0	0
16248	0.01	0	0	0	0	0	0
16249	0	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0	0
16251	0.0007	0	0	0	0	0	0
16252	0.005	0	0	0	0	0	0

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16253	0.01776	1,056,810	0	211,362	0	0	1,268,173	139,239
TOTALS	2.694	34,149,683	101,563	4,701,313	0	0	38,952,560	4,276,782

(a) Amortization assuming 7% interest over 15 year period.

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16001	0.0793	623,747	4,078	11,540	639,365	927,325
16003	0.004715	0	0	0	0	0
16009	0.01613	0	0	0	0	0
16011	0	0	0	0	0	0
16012	0.002205	0	0	0	0	0
16013	0.015	0	0	0	0	0
16014	0	0	0	0	0	0
16015	0.0005	0	0	0	0	0
16016	0.002304	0	0	0	0	0
16020	0.045814	0	0	0	0	0
16023	0.057344	0	0	0	0	0
16024	0.005918	62,491	3,377	11,540	77,408	157,228
16025	0	0	0	0	0	0
16026	0	0	0	0	0	0
16027	0	0	0	0	0	0
16028	0.01985	0	0	0	0	0
16029	0.025	0	0	0	0	0
16033	0.0091	0	0	0	0	0
16035	0	0	0	0	0	0
16038	0.008219	81,552	1,516	9,876	92,944	173,123
16039	0.00178	0	0	0	0	0
16043	0.002177	32,492	3,173	10,500	46,165	79,987
16046	0	0	0	0	0	0
16047	0.001148	23,878	1,917	11,540	37,335	58,632
16048	5.0000E-06	14,452	0	0	14,452	20,254
16049	0.0017	27,615	2,208	11,540	41,363	74,272
16050	0.01	84,672	1,917	11,540	98,129	185,864
16052	0.0546	416,379	6,897	11,072	434,348	691,879

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16053	0.00124	18,054	1,917	11,540	31,511	52,609
16054	0.00075	17,488	1,917	11,357	30,762	47,344
16055	8.0000E-06	7,737	0	0	7,737	12,513
16056	0.001367	25,638	1,917	11,540	39,095	63,296
16058	0.003	30,836	1,917	0	32,753	80,688
16059	0.0011	23,498	1,917	11,540	36,955	57,641
16060	0.0018	29,301	2,208	11,540	43,049	72,563
16061	0	0	0	0	0	0
16062	0.00005	8,043	0	0	8,043	19,366
16063	0.0067	69,765	3,562	11,540	84,867	158,088
16064	0.011967	99,486	3,931	11,540	114,957	212,406
16065	0.008	79,121	3,231	11,090	93,442	190,289
16070	0.001328	0	0	0	0	0
16071	0.006	0	0	0	0	0
16073	0.0182	0	0	0	0	0
16074	0	0	0	0	0	0
16075	0.010209	97,267	1,516	10,500	109,283	200,532
16076	0	0	0	0	0	0
16077	0.00816	0	0	0	0	0
16078	0.00499	0	0	0	0	0
16079	0.112474	848,079	0	11,180	859,259	1,196,918
16083	0.001	21,873	1,735	11,540	35,148	57,279
16084	0.006427	0	0	0	0	0
16085	0.03	0	0	0	0	0
16088	0.03621	0	0	0	0	0
16090	0.003929	0	0	0	0	0
16091	0.232098	0	0	0	0	0
16092	0.006682	0	0	0	0	0

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16093	0.081575	625,858	0	11,180	637,038	929,719
16097	0.019	138,700	0	10,520	149,220	289,912
16098	0	0	0	0	0	0
16099	0.01533	0	0	0	0	0
16102	0.01394	127,227	0	11,540	138,767	275,208
16103	0.037558	0	0	0	0	0
16107	0.001286	0	0	0	0	0
16109	0.050559	0	0	0	0	0
16111	0.0072	73,455	1,516	10,500	85,471	159,393
16113	0	0	0	0	0	0
16114	0.00864	0	0	0	0	0
16115	0.004071	0	0	0	0	0
16116	0.0042	0	0	0	0	0
16117	0.04	310,524	0	9,908	320,432	526,316
16118	0.0288	0	0	0	0	0
16119	0.007288	53,202	0	11,117	64,319	143,783
16120	0.042775	312,258	0	9,200	321,458	528,251
16121	0.080284	0	0	0	0	0
16122	0.0255	186,150	0	9,948	196,098	359,576
16123	0.04608	375,504	8,365	11,540	395,409	642,183
16124	0.016662	150,728	11,381	11,540	173,649	301,540
16125	0.014193	103,609	0	10,712	114,321	234,145
16127	0.003627	38,161	2,756	11,540	52,457	108,457
16128	0.003963	0	0	0	0	0
16129	0.00469	34,237	0	11,540	45,777	104,342
16130	0.0003	2,190	0	11,540	13,730	18,509
16131	0.03	0	0	0	0	0
16132	0.03	0	0	0	0	0

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16135	0.011487	0	0	0	0	0
16137	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0
16148	0.000077	0	0	0	0	0
16149	0	0	0	0	0	0
16150	0.045778	0	0	0	0	0
16151	0.002049	0	0	0	0	0
16152	0	0	0	0	0	0
16153	0.008	0	0	0	0	0
16154	0.010224	0	0	0	0	0
16155	0.00831	0	0	0	0	0
16156	0.173	0	0	0	0	0
16158	0.014275	0	0	0	0	0
16159	0.225	0	0	0	0	0
16160	0.000137	0	0	0	0	0
16161	0.053	0	0	0	0	0
16162	0.0009	0	0	0	0	0
16163	0	0	0	0	0	0
16164	0.01	0	0	0	0	0
16165	0.030218	0	0	0	0	0
16166	0.003416	0	0	0	0	0
16170	0.0048	44,634	4,078	11,235	59,947	127,036
16171	0.024	0	0	0	0	0
16173	0.025	0	0	0	0	0
16174	0.0072	0	0	0	0	0
16175	0	0	0	0	0	0
16176	0.037272	0	0	0	0	0
16177	0	0	0	0	0	0

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16180	0	0	0	0	0	0
16185	0	0	0	0	0	0
16186	0.00304	0	0	0	0	0
16187	0.003	0	0	0	0	0
16189	0	0	0	0	0	0
16191	0	0	0	0	0	0
16193	0.002303	0	0	0	0	0
16196	0.012233	115,547	10,115	11,540	137,202	244,531
16199	0.0008	0	0	0	0	0
16200	0.011416	0	0	0	0	0
16201	0.001881	0	0	0	0	0
16202	0.013007	0	0	0	0	0
16203	0.02	0	0	0	0	0
16204	0	0	0	0	0	0
16205	0	0	0	0	0	0
16206	0.057389	0	0	0	0	0
16208	0.003342	0	0	0	0	0
16211	0.15	0	0	0	0	0
16212	0.0007	20,233	1,516	10,500	32,249	47,264
16215	0	0	0	0	0	0
16217	0	0	0	0	0	0
16219	0.025438	0	0	0	0	0
16220	0.030405	0	0	0	0	0
16221	0.006616	0	0	0	0	0
16222	0.01548	0	0	0	0	0
16223	0.029041	246,811	8,212	10,500	265,523	434,528
16224	0	0	0	0	0	0
16225	0.031	0	0	0	0	0

Table 9-13 - BAT Option III Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING	TOTAL O & M	
16228	0.000719	0	0	0	0	0
16230	0	0	0	0	0	0
16233	0.0097	95,062	9,277	11,540	115,879	209,272
16234	0.030827	0	0	0	0	0
16236	0.005946	0	0	0	0	0
16239	0	0	0	0	0	0
16240	0.005597	0	0	0	0	0
16241	0	0	0	0	0	0
16242	0.0005	0	0	0	0	0
16245	0	0	0	0	0	0
16246	0.001353	0	0	0	0	0
16248	0.01	0	0	0	0	0
16249	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0
16251	0.0007	0	0	0	0	0
16252	0.005	0	0	0	0	0
16253	0.01776	143,068	0	11,068	154,136	293,374
TOTALS	2.694	5,940,621	108,068	432,763	6,481,452	10,767,432

(b) Off-site disposal costs used for low flow facilities 16048, 16055, and 16062

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND	
16001	0.0793	0	0	0	0	0	0
16003	0.004715	47,897	2,004	0	0	0	49,901
16009	0.01613	125,436	6,492	0	0	0	131,927
16011	0	0	0	0	0	0	0
16012	0.002205	41,812	2,004	0	0	0	43,816
16013	0.015	120,535	13,491	0	0	0	134,026
16014	0	0	0	0	0	0	0
16015	0.0005	1,914	0	383	0	0	2,297
16016	0.002304	42,070	2,004	0	0	0	44,074
16020	0.045814	237,707	14,181	0	0	0	251,888
16023	0.057344	292,033	35,254	0	0	0	327,287
16024	0.005918	0	0	0	0	0	0
16025	0	0	0	0	0	0	0
16026	0	0	0	0	0	0	0
16027	0	0	0	0	0	0	0
16028	0.01985	81,397	0	16,279	0	0	97,676
16029	0.025	165,849	19,449	0	0	0	185,298
16033	0.0091	17,601	0	3,520	0	0	21,121
16035	0	0	0	0	0	0	0
16038	0.008219	0	0	0	0	0	0
16039	0.00178	40,483	9,041	9,905	0	0	59,429
16043	0.002177	0	0	0	0	0	0
16046	0	0	0	0	0	0	0
16047	0.001148	0	0	0	0	0	0
16048	5.0000E-06	0	0	0	0	0	0
16049	0.0017	0	0	0	0	0	0
16050	0.01	0	0	0	0	0	0
16052	0.0546	0	0	0	0	0	0
16053	0.00124	0	0	0	0	0	0
16054	0.00075	0	0	0	0	0	0
16055	8.0000E-06	0	0	0	0	0	0
16056	0.001367	0	0	0	0	0	0
16058	0.003	0	0	0	0	0	0
16059	0.0011	0	0	0	0	0	0
16060	0.0018	0	0	0	0	0	0
16061	0	0	0	0	0	0	0
16062	0.00005	0	0	0	0	0	0
16063	0.0067	0	0	0	0	0	0
16064	0.011967	0	0	0	0	0	0

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16065	0.008	0	0	0	0	0	0	0
16070	0.001328	40,086	2,393	0	0	0	42,480	4,664
16071	0.006	72,865	6,992	0	0	0	79,856	8,768
16073	0.0182	130,976	0	26,195	0	0	157,171	17,257
16074	0	0	0	0	0	0	0	0
16075	0.010209	0	0	0	0	0	0	0
16076	0	0	0	0	0	0	0	0
16077	0.00816	15,799	0	3,160	0	0	18,959	2,082
16078	0.00499	39,516	2,004	8,304	0	0	49,824	5,470
16079	0.112474	0	0	0	0	0	0	0
16083	0.001	0	0	0	0	0	0	0
16084	0.006427	73,692	2,640	0	0	0	76,332	8,381
16085	0.03	67,242	2,004	13,849	0	0	83,095	9,123
16088	0.03621	174,944	25,359	40,061	0	0	240,364	26,391
16090	0.003929	58,795	5,166	0	0	0	63,961	7,023
16091	0.232098	910,395	94,859	0	0	0	1,005,254	110,371
16092	0.006682	12,956	0	2,591	0	0	15,548	1,707
16093	0.081575	0	0	0	0	0	0	0
16097	0.019	0	0	0	0	0	0	0
16098	0	0	0	0	0	0	0	0
16099	0.01533	29,441	0	5,888	0	0	35,329	3,879
16102	0.01394	0	0	0	0	0	0	0
16103	0.037558	192,741	53,744	49,297	0	0	295,781	32,475
16107	0.001286	39,769	2,004	8,355	0	0	50,128	5,504
16109	0.050559	266,696	32,214	0	0	0	298,909	32,819
16111	0.0072	0	0	0	0	0	0	0
16113	0	0	0	0	0	0	0	0
16114	0.00864	87,346	9,092	0	0	0	96,437	10,588
16115	0.004071	0	0	0	0	0	0	0
16116	0.0042	53,455	14,284	13,548	0	0	81,287	8,925
16117	0.04	0	0	0	0	0	0	0
16118	0.0288	15,429	0	3,086	0	0	18,515	2,033
16119	0.007288	0	0	0	0	0	0	0
16120	0.042775	0	0	0	0	0	0	0
16121	0.080284	19,873	0	3,975	0	0	23,848	2,618
16122	0.0255	0	0	0	0	0	0	0
16123	0.04608	0	0	0	0	0	0	0
16124	0.016662	0	0	0	0	0	0	0
16125	0.014193	0	0	0	0	0	0	0

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16127	0.003627	0	0	0	0	0	0	0
16128	0.003963	37,727	2,004	7,946	0	0	47,677	5,235
16129	0.00469	0	0	0	0	0	0	0
16130	0.0003	0	0	0	0	0	0	0
16131	0.03	157,251	24,649	36,380	0	0	218,279	23,966
16132	0.03	51,813	0	10,363	0	0	62,175	6,827
16135	0.011487	22,158	0	4,432	0	0	26,589	2,919
16137	0	0	0	0	0	0	0	0
16139	0.00005	0	0	0	0	0	0	0
16148	0.000077	0	0	0	0	0	0	0
16149	0	0	0	0	0	0	0	0
16150	0.045778	118,519	2,004	0	0	0	120,523	13,233
16151	0.002049	45,631	3,256	0	0	0	48,887	5,368
16152	0.152866	622,947	71,188	0	0	0	694,135	76,212
16153	0.008	82,232	3,068	0	0	0	85,300	9,365
16154	0.010224	93,576	2,049	0	0	0	95,626	10,499
16155	0.00831	83,819	2,004	0	0	0	85,823	9,423
16156	0.173	344,298	2,004	0	0	0	346,302	38,022
16158	0.014275	97,602	2,600	20,040	0	0	120,242	13,202
16159	0.225	528,407	18,860	109,453	0	0	656,721	72,104
16160	0.000137	0	0	0	0	0	0	0
16161	0.053	222,783	28,208	50,198	0	0	301,188	33,069
16162	0.0009	30,262	2,004	6,453	0	0	38,720	4,251
16163	0	0	0	0	0	0	0	0
16164	0.01	85,263	0	17,053	0	0	102,316	11,234
16165	0.030218	177,387	71,231	49,724	0	0	298,343	32,756
16166	0.003416	55,354	2,004	0	0	0	57,359	6,298
16170	0.0048	0	0	0	0	0	0	0
16171	0.024	135,954	19,101	31,011	0	0	186,065	20,429
16173	0.025	165,849	19,449	0	0	0	185,298	20,345
16174	0.0072	67,584	2,004	13,918	0	0	83,506	9,169
16175	0	0	0	0	0	0	0	0
16176	0.037272	176,340	15,283	38,324	0	0	229,946	25,247
16177	0	0	0	0	0	0	0	0
16180	0	0	0	0	0	0	0	0
16185	0	0	0	0	0	0	0	0
16186	0.00304	52,785	4,305	0	0	0	57,091	6,268
16187	0.003	52,349	4,271	0	0	0	56,621	6,217
16189	0	0	0	0	0	0	0	0

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
16191	0	0	0	0	0	0	0	0
16193	0.002303	47,410	3,512	0	0	0	50,922	5,591
16196	0.012233	0	0	0	0	0	0	0
16199	0.0008	35,016	2,004	0	0	0	37,020	4,065
16200	0.011416	101,014	3,967	0	0	0	104,981	11,526
16201	0.001881	33,243	0	6,649	0	0	39,891	4,380
16202	0.013007	111,523	12,179	0	0	0	123,701	13,582
16203	0.02	144,527	16,567	0	0	0	161,094	17,687
16204	0	0	0	0	0	0	0	0
16205	0.015179	121,242	13,596	0	0	0	134,839	14,805
16206	0.057389	292,102	35,284	0	0	0	327,385	35,945
16208	0.003342	54,851	4,598	0	0	0	59,449	6,527
16211	0.15	610,433	70,224	0	0	0	680,657	74,732
16212	0.0007	0	0	0	0	0	0	0
16215	0.017641	133,355	15,142	0	0	0	148,497	16,304
16217	0	0	0	0	0	0	0	0
16219	0.025438	167,563	19,685	0	0	0	187,248	20,559
16220	0.030405	189,093	22,378	0	0	0	211,470	23,218
16221	0.006616	76,285	7,505	0	0	0	83,790	9,200
16222	0.01548	121,001	4,950	0	0	0	125,951	13,829
16223	0.029041	0	0	0	0	0	0	0
16224	0	0	0	0	0	0	0	0
16225	0.031	191,293	22,688	0	0	0	213,981	23,494
16228	0.000719	34,183	2,004	0	0	0	36,187	3,973
16230	0	0	0	0	0	0	0	0
16234	0.030827	190,707	22,601	0	0	0	213,308	23,420
16236	0.005946	72,751	6,937	0	0	0	79,688	8,749
16239	0	0	0	0	0	0	0	0
16240	0.005597	70,635	6,659	0	0	0	77,294	8,486
16241	0	0	0	0	0	0	0	0
16242	0.0005	31,581	2,004	0	0	0	33,585	3,687
16245	0	0	0	0	0	0	0	0
16246	0.001353	40,163	2,393	0	0	0	42,556	4,672
16248	0.01	94,149	3,689	0	0	0	97,838	10,742
16249	0	0	0	0	0	0	0	0
16250	0.0002	0	0	0	0	0	0	0
16251	0.0007	34,106	2,004	0	0	0	36,110	3,965
16252	0.005	65,403	6,149	0	0	0	71,553	7,856
16253	0.01776	0	0	0	0	0	0	0

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory

ID#	FLOW (MGD)	CAPITAL COSTS (\$)					TOTAL CAPITAL	AMORTIZED TOTAL CAPITAL(a) (\$/YR)
		EQUIPMENT	SLUDGE HANDLING	RETROFIT	PERMIT MODIFICATION	LAND		
TOTALS	2.870	10,088,267	966,939	610,339	0	0	11,665,545	1,280,814

(a) Amortization assuming 7% interest over 15 year period.

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16001	0.0793	0	0	0	0	0	0
16003	0.004715	10,302	1,516	4,888	16,706	22,185	
16009	0.01613	15,436	7,462	4,888	27,786	42,271	
16011	0	0	0	0	0	0	0
16012	0.002205	9,418	2,340	936	12,694	17,505	
16013	0.015	15,170	10,919	936	27,025	41,740	
16014	0	0	0	0	0	0	0
16015	0.0005	2,916	0	0	2,916	3,168	
16016	0.002304	9,459	2,340	936	12,735	17,575	
16020	0.045814	21,738	11,225	4,408	37,371	65,027	
16023	0.057344	26,759	18,170	936	45,865	81,799	
16024	0.005918	0	0	0	0	0	0
16025	0	0	0	0	0	0	0
16026	0	0	0	0	0	0	0
16027	0	0	0	0	0	0	0
16028	0.01985	20,673	0	756	21,429	32,154	
16029	0.025	18,458	13,245	936	32,639	52,983	
16033	0.0091	8,050	0	936	8,986	11,305	
16035	0	0	0	0	0	0	0
16038	0.008219	0	0	0	0	0	0
16039	0.00178	10,095	8,859	810	19,765	26,289	
16043	0.002177	0	0	0	0	0	0
16046	0	0	0	0	0	0	0
16047	0.001148	0	0	0	0	0	0
16048	5.0000E-06	0	0	0	0	0	0
16049	0.0017	0	0	0	0	0	0
16050	0.01	0	0	0	0	0	0
16052	0.0546	0	0	0	0	0	0

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16053	0.00124	0	0	0	0	0	0
16054	0.00075	0	0	0	0	0	0
16055	8.0000E-06	0	0	0	0	0	0
16056	0.001367	0	0	0	0	0	0
16058	0.003	0	0	0	0	0	0
16059	0.0011	0	0	0	0	0	0
16060	0.0018	0	0	0	0	0	0
16061	0	0	0	0	0	0	0
16062	0.00005	0	0	0	0	0	0
16063	0.0067	0	0	0	0	0	0
16064	0.011967	0	0	0	0	0	0
16065	0.008	0	0	0	0	0	0
16070	0.001328	8,891	4,482	936	14,309	18,973	
16071	0.006	11,667	7,762	936	20,366	29,133	
16073	0.0182	17,121	0	936	18,057	35,313	
16074	0	0	0	0	0	0	0
16075	0.010209	0	0	0	0	0	0
16076	0	0	0	0	0	0	0
16077	0.00816	7,649	0	936	8,585	10,667	
16078	0.00499	9,485	2,340	936	12,761	18,232	
16079	0.112474	0	0	0	0	0	0
16083	0.001	0	0	0	0	0	0
16084	0.006427	11,060	4,704	4,888	20,652	29,033	
16085	0.03	12,747	2,340	936	16,024	25,147	
16088	0.03621	17,236	15,248	936	33,420	59,811	
16090	0.003929	10,144	6,636	936	17,716	24,739	
16091	0.232098	68,857	31,154	936	100,947	211,319	
16092	0.006682	6,966	0	936	7,902	9,609	

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16093	0.081575	0	0	0	0	0	0
16097	0.019	0	0	0	0	0	0
16098	0	0	0	0	0	0	0
16099	0.01533	10,297	0	774	11,071	14,950	14,950
16102	0.01394	0	0	0	0	0	0
16103	0.037558	19,970	22,855	936	43,761	76,236	76,236
16107	0.001286	9,029	2,340	936	12,305	17,809	17,809
16109	0.050559	25,134	17,323	936	43,393	76,212	76,212
16111	0.0072	0	0	0	0	0	0
16113	0	0	0	0	0	0	0
16114	0.00864	12,507	8,896	936	22,339	32,927	32,927
16115	0.004071	0	0	864	864	864	864
16116	0.0042	10,147	11,266	936	22,349	31,273	31,273
16117	0.04	0	0	0	0	0	0
16118	0.0288	2,848	0	936	3,784	5,816	5,816
16119	0.007288	0	0	0	0	0	0
16120	0.042775	0	0	0	0	0	0
16121	0.080284	3,431	0	936	4,367	6,986	6,986
16122	0.0255	0	0	0	0	0	0
16123	0.04608	0	0	0	0	0	0
16124	0.016662	0	0	0	0	0	0
16125	0.014193	0	0	0	0	0	0
16127	0.003627	0	0	0	0	0	0
16128	0.003963	9,222	2,340	936	12,498	17,733	17,733
16129	0.00469	0	0	0	0	0	0
16130	0.0003	0	0	0	0	0	0
16131	0.03	16,531	15,013	936	32,480	56,446	56,446
16132	0.03	9,900	0	936	10,836	17,662	17,662

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16135	0.011487	8,983	0	936	9,919	12,838	
16137	0	0	0	0	0	0	
16139	0.00005	0	0	900	900	8,200	
16148	0.000077	0	0	936	936	12,178	
16149	0	0	0	0	0	0	
16150	0.045778	17,873	2,340	936	21,150	34,383	
16151	0.002049	9,271	5,223	936	15,429	20,797	
16152	0.152866	48,773	26,710	936	76,419	152,631	
16153	0.008	11,559	5,073	4,888	21,520	30,885	
16154	0.010224	12,203	4,115	936	17,254	27,753	
16155	0.00831	11,652	3,826	936	16,414	25,837	
16156	0.173	39,529	2,340	936	42,805	80,828	
16158	0.014275	11,764	4,667	864	17,295	30,497	
16159	0.225	30,252	13,047	936	44,234	116,339	
16160	0.000137	0	0	936	936	20,938	
16161	0.053	19,793	16,123	864	36,781	69,850	
16162	0.0009	7,964	2,340	936	11,241	15,492	
16163	0	0	0	0	0	0	
16164	0.01	12,685	0	936	13,621	24,854	
16165	0.030218	19,950	26,711	936	47,597	80,354	
16166	0.003416	9,926	2,777	936	13,639	19,937	
16170	0.0048	0	0	0	0	0	
16171	0.024	14,992	13,125	882	28,999	49,428	
16173	0.025	18,458	13,245	936	32,639	52,983	
16174	0.0072	10,280	3,608	936	14,824	23,992	
16175	0	0	0	0	0	0	
16176	0.037272	16,993	11,653	882	29,527	54,774	
16177	0	0	0	0	0	0	

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16180	0	0	0	0	0	0	0
16185	0	0	0	0	0	0	0
16186	0.00304	9,758	6,039	936	16,733	23,002	23,002
16187	0.003	9,736	6,003	936	16,675	22,892	22,892
16189	0	0	0	0	0	0	0
16191	0	0	0	0	0	0	0
16193	0.002303	9,400	5,444	936	15,780	21,371	21,371
16196	0.012233	0	0	0	0	0	0
16199	0.0008	8,486	3,680	936	13,101	17,166	17,166
16200	0.011416	13,278	5,778	4,888	23,944	35,470	35,470
16201	0.001881	8,505	0	936	9,441	13,821	13,821
16202	0.013007	14,681	10,345	936	25,962	39,543	39,543
16203	0.02	17,086	12,156	936	30,179	47,866	47,866
16204	0	0	0	0	0	0	0
16205	0.015179	15,211	10,958	936	27,105	41,910	41,910
16206	0.057389	26,765	18,206	936	45,908	81,853	81,853
16208	0.003342	9,893	6,264	936	17,093	23,620	23,620
16211	0.15	47,788	26,498	936	75,221	149,954	149,954
16212	0.0007	0	0	0	0	0	0
16215	0.017641	16,209	11,613	0	27,821	44,126	44,126
16217	0	0	0	0	0	0	0
16219	0.025438	18,548	13,323	936	32,806	53,365	53,365
16220	0.030405	20,127	14,263	936	35,326	58,545	58,545
16221	0.006616	11,873	8,062	936	20,871	30,070	30,070
16222	0.01548	14,843	6,488	936	22,267	36,096	36,096
16223	0.029041	0	0	0	0	0	0
16224	0	0	0	0	0	0	0
16225	0.031	20,243	14,379	936	35,558	59,051	59,051

Table 9-14 - PSES Option I Subtitle D Non-Hazardous Subcategory Cont'd

ID#	FLOW (MGD)	O & M COSTS (\$/YR)				TOTAL O & M	TOTAL ANNUAL COST (\$/YR)(b)
		EQUIPMENT	SOLIDS HANDLING	MONITORING			
16228	0.000719	8,412	3,572	936	12,920	16,893	
16230	0	0	0	0	0	0	
16234	0.030827	20,210	14,340	936	35,486	58,906	
16236	0.005946	11,653	7,725	936	20,314	29,063	
16239	0	0	0	0	0	0	
16240	0.005597	11,529	7,573	936	20,038	28,525	
16241	0	0	0	0	0	0	
16242	0.0005	8,182	3,101	936	12,219	15,907	
16245	0	0	0	0	0	0	
16246	0.001353	8,905	4,482	936	14,323	18,995	
16248	0.01	12,894	5,593	4,888	23,375	34,117	
16249	0	0	0	0	0	0	
16250	0.0002	0	0	936	936	30,136	
16251	0.0007	8,396	3,497	936	12,830	16,794	
16252	0.005	10,560	7,273	936	18,768	26,624	
16253	0.01776	0	0	0	0	0	
TOTALS	2.870	1,205,386	624,354	104,044	1,933,783	3,282,341	

(b) Off-site disposal costs used for low flow facilities 16139, 16148, 16160, 16250

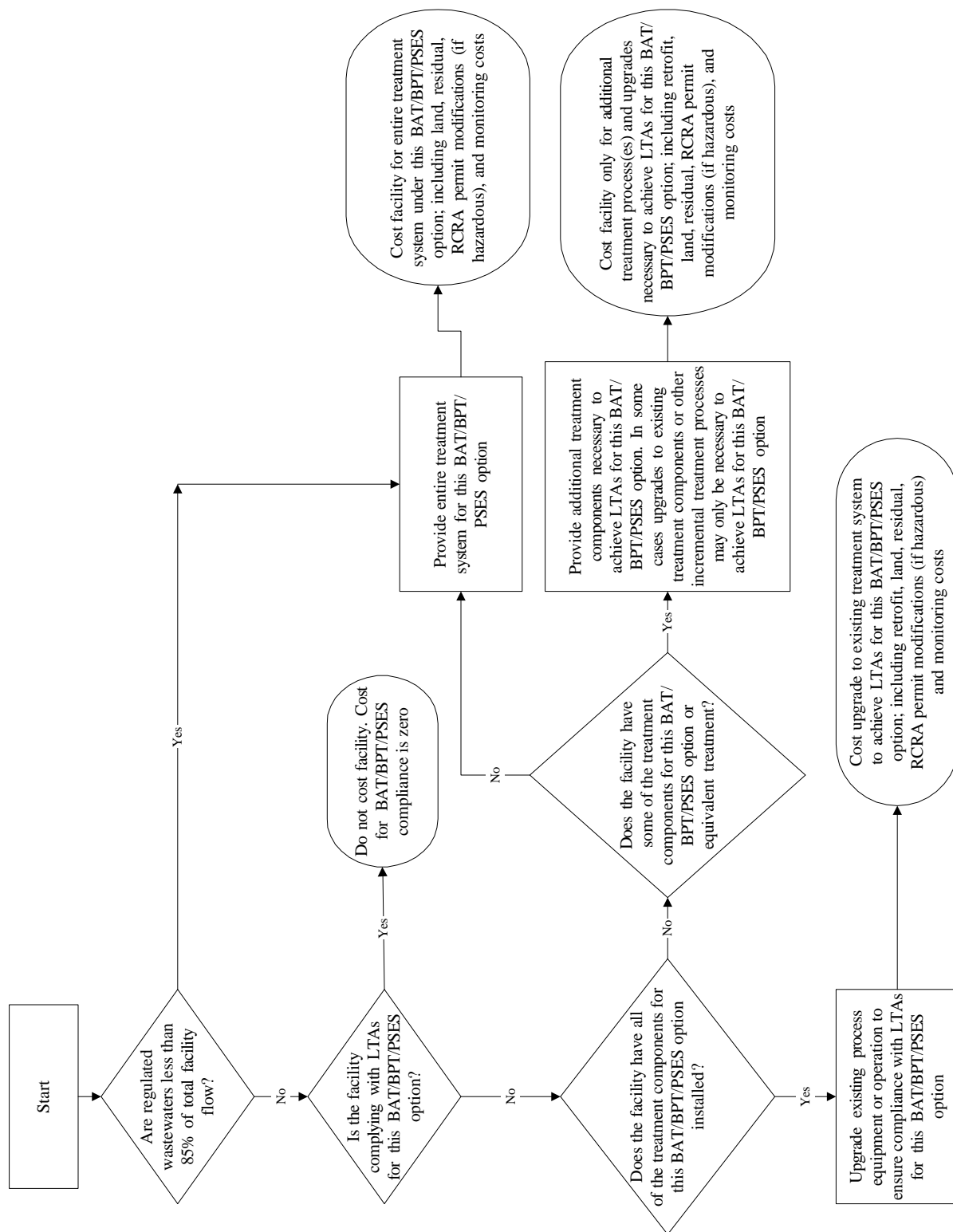


Figure 9-1: Option-Specific Costing Logic Flow Diagram

Figure 9-2
Equalization Capital Cost Curve

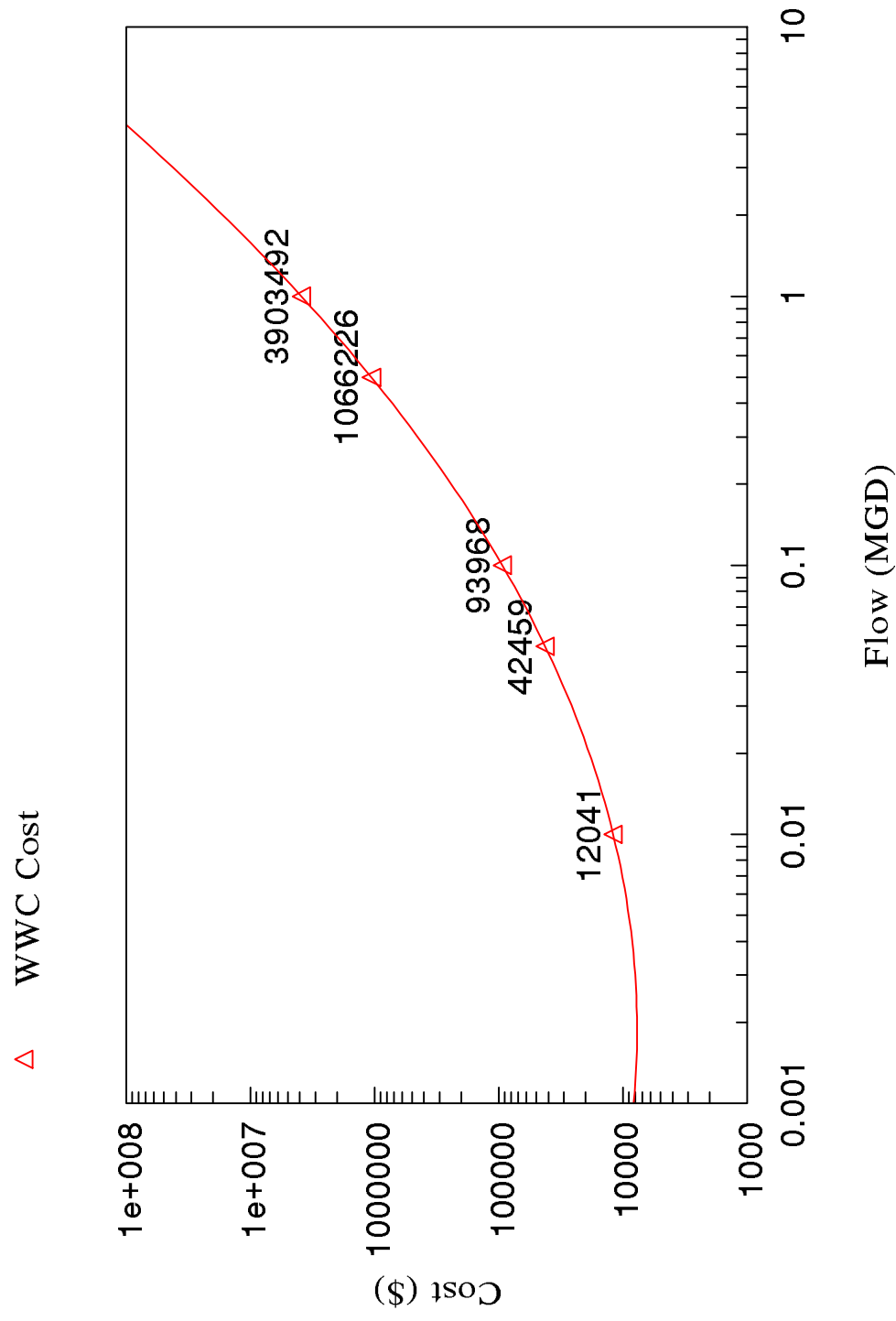


Figure 9-3
Flocculation Capital Cost Curve

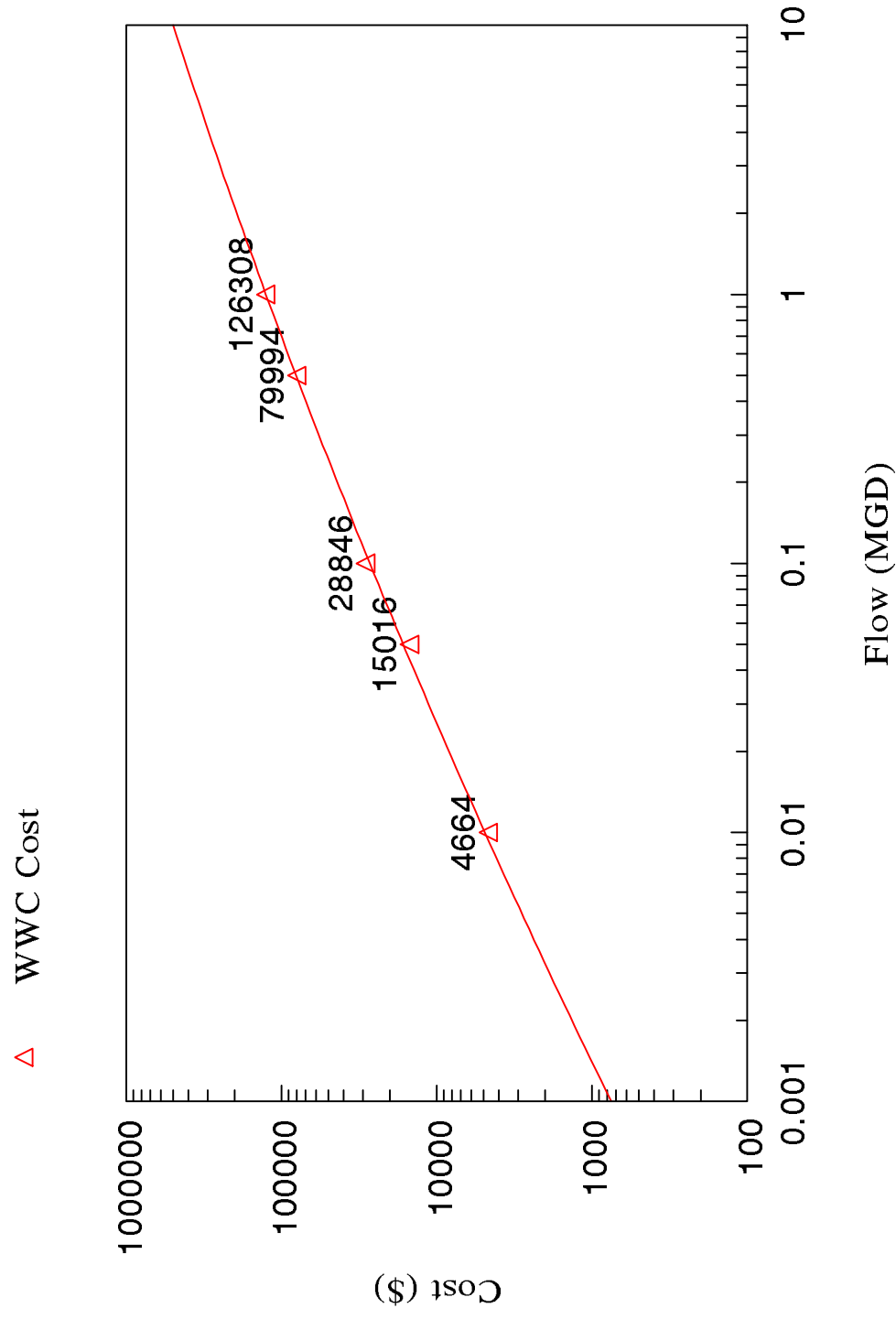


Figure 9-4
Flocculation O&M Cost Curve

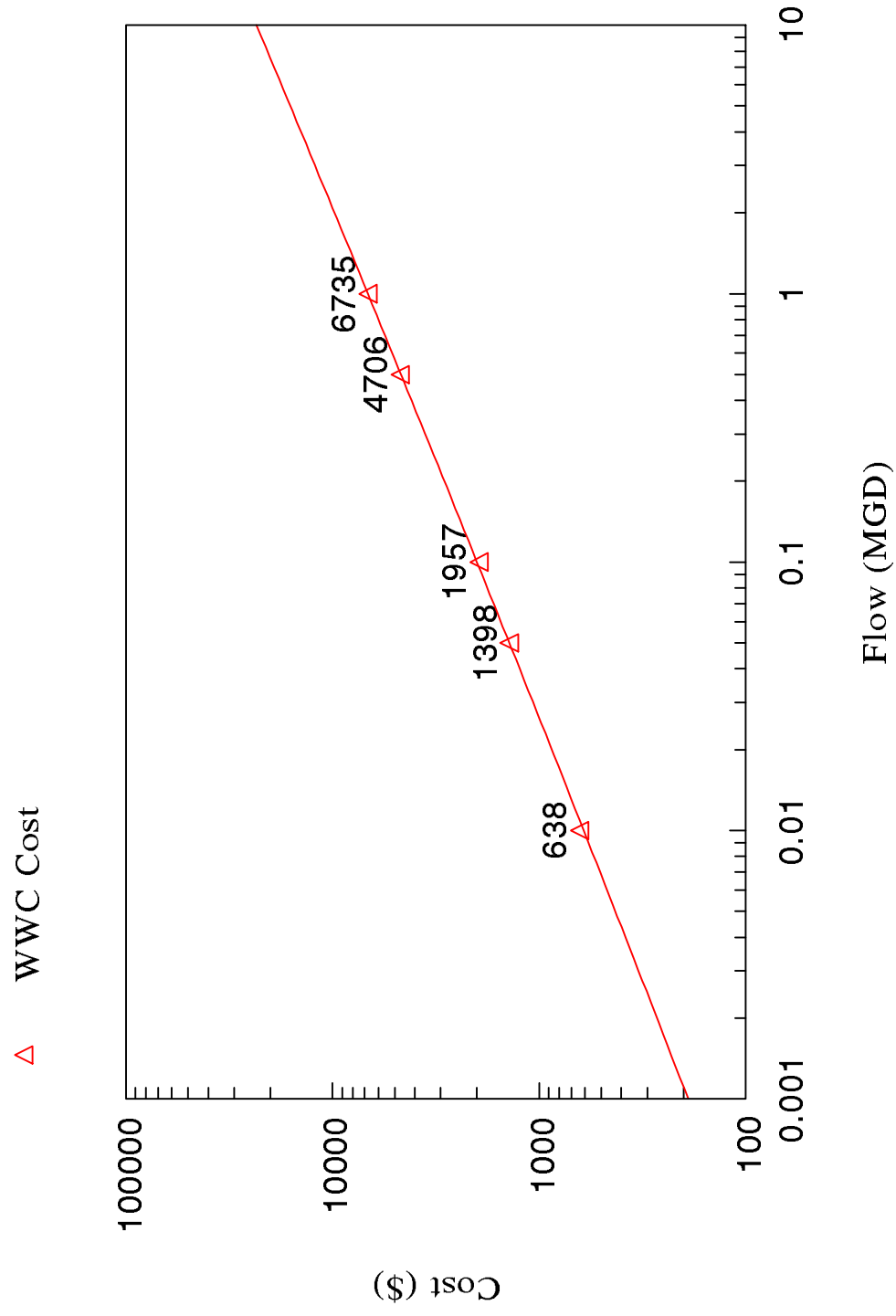


Figure 9-5
Sodium Hydroxide Capital Cost Curve

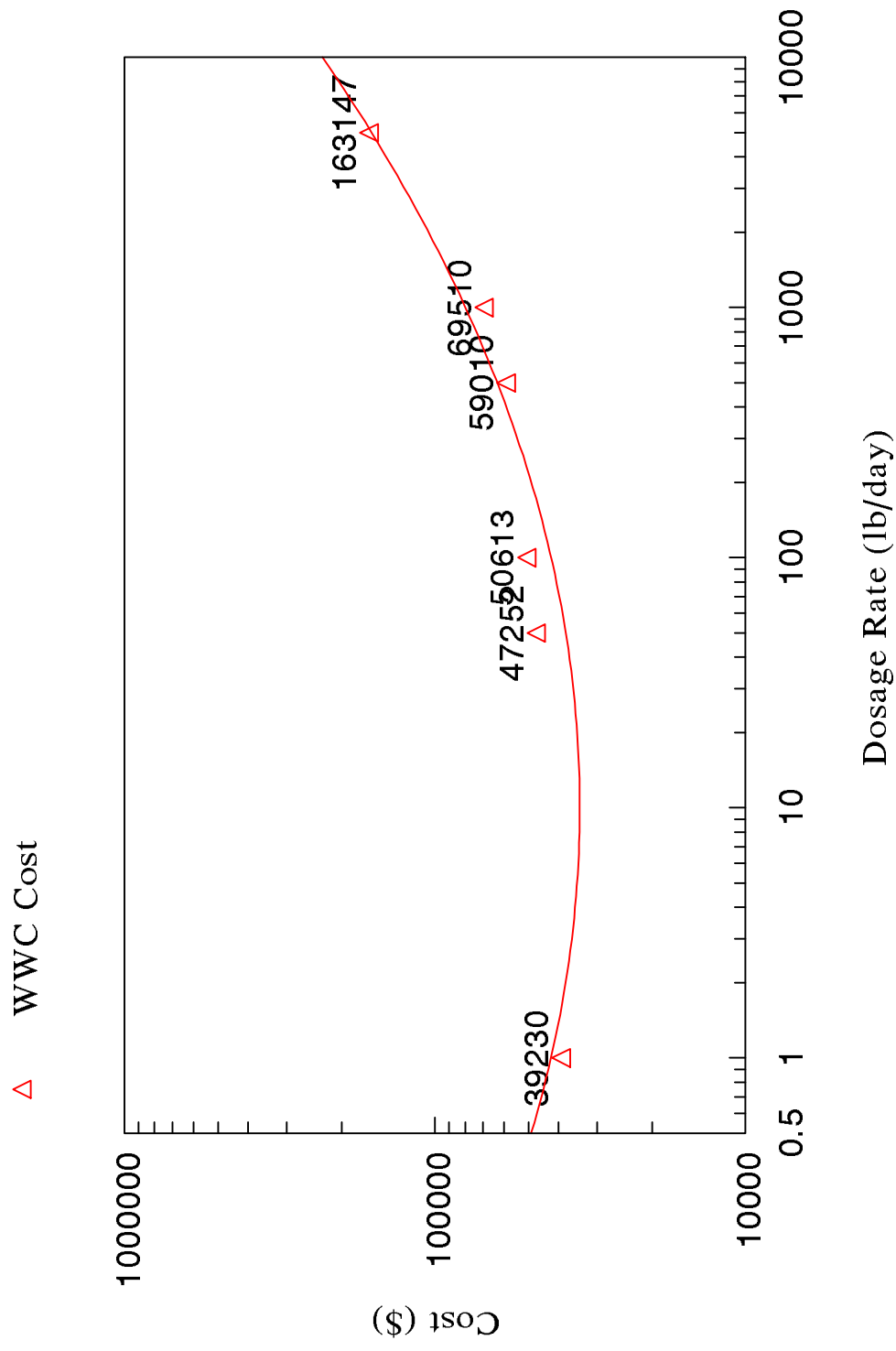


Figure 9-6
Sodium Hydroxide O&M Cost Curve

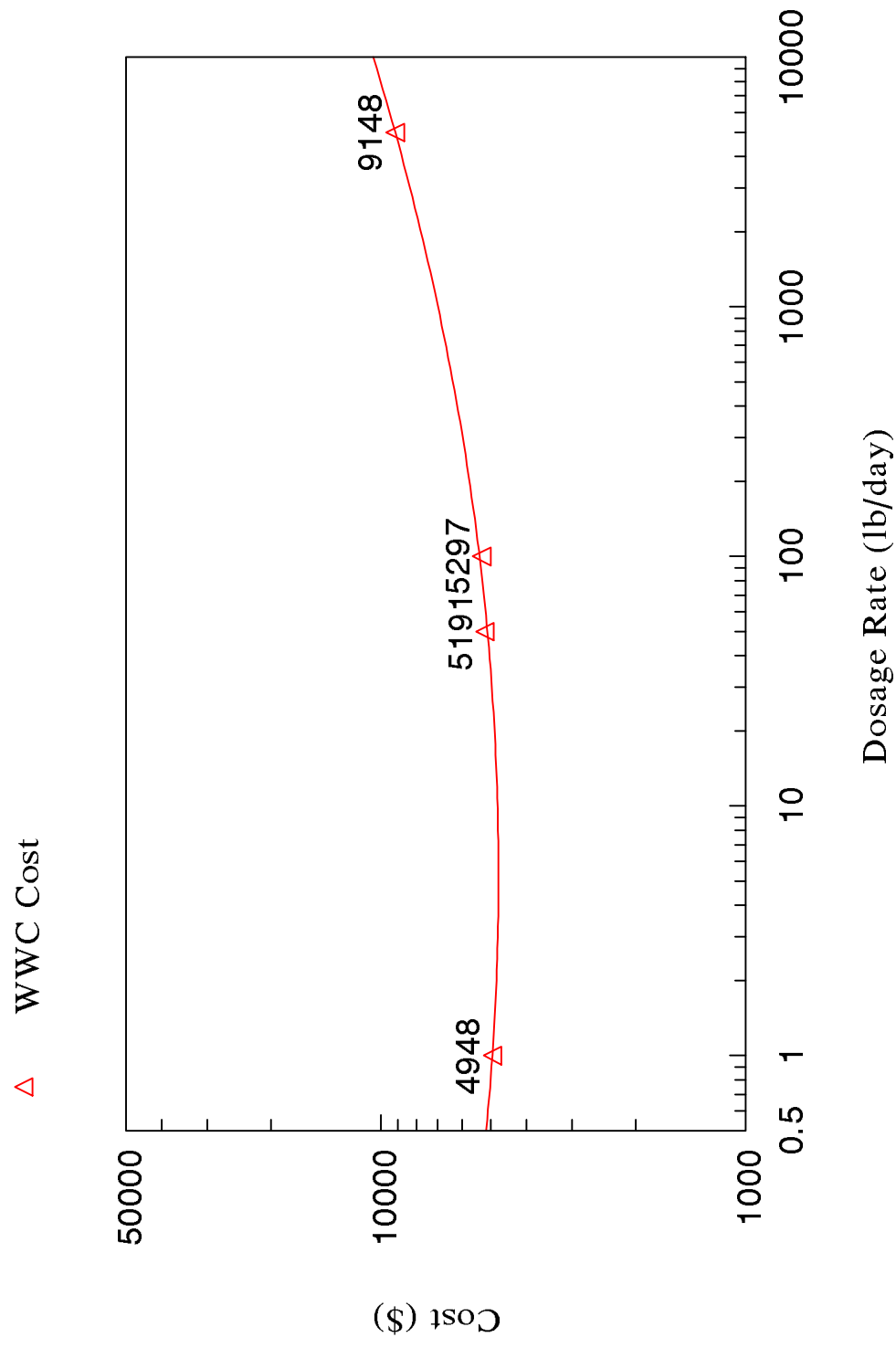


Figure 9-7
Phosphoric Acid Feed Capital Cost Curve

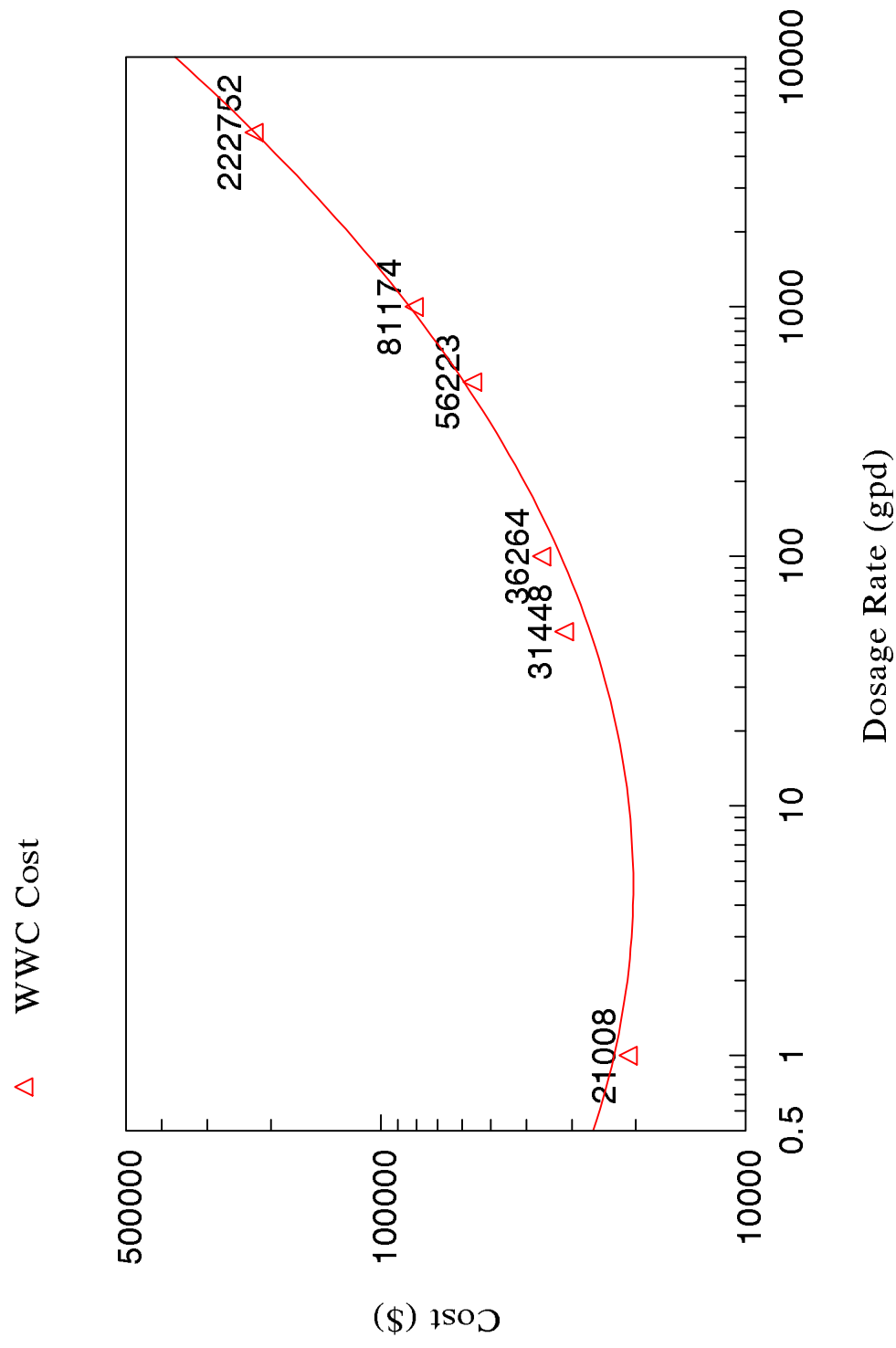


Figure 9-8
Phosphoric Acid Feed O&M Cost Curve

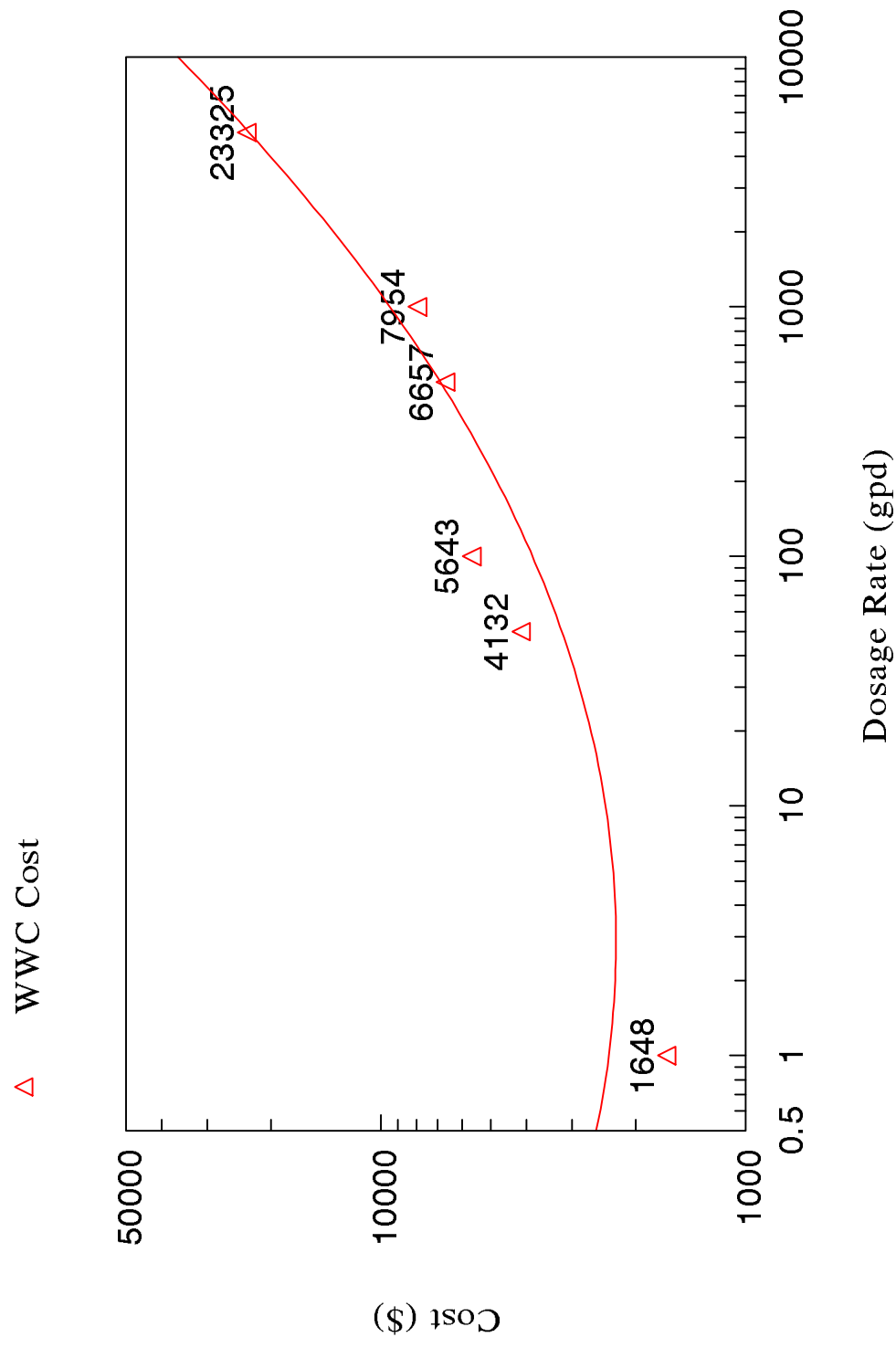


Figure 9-9
Polymer Feed Capital Cost Curve

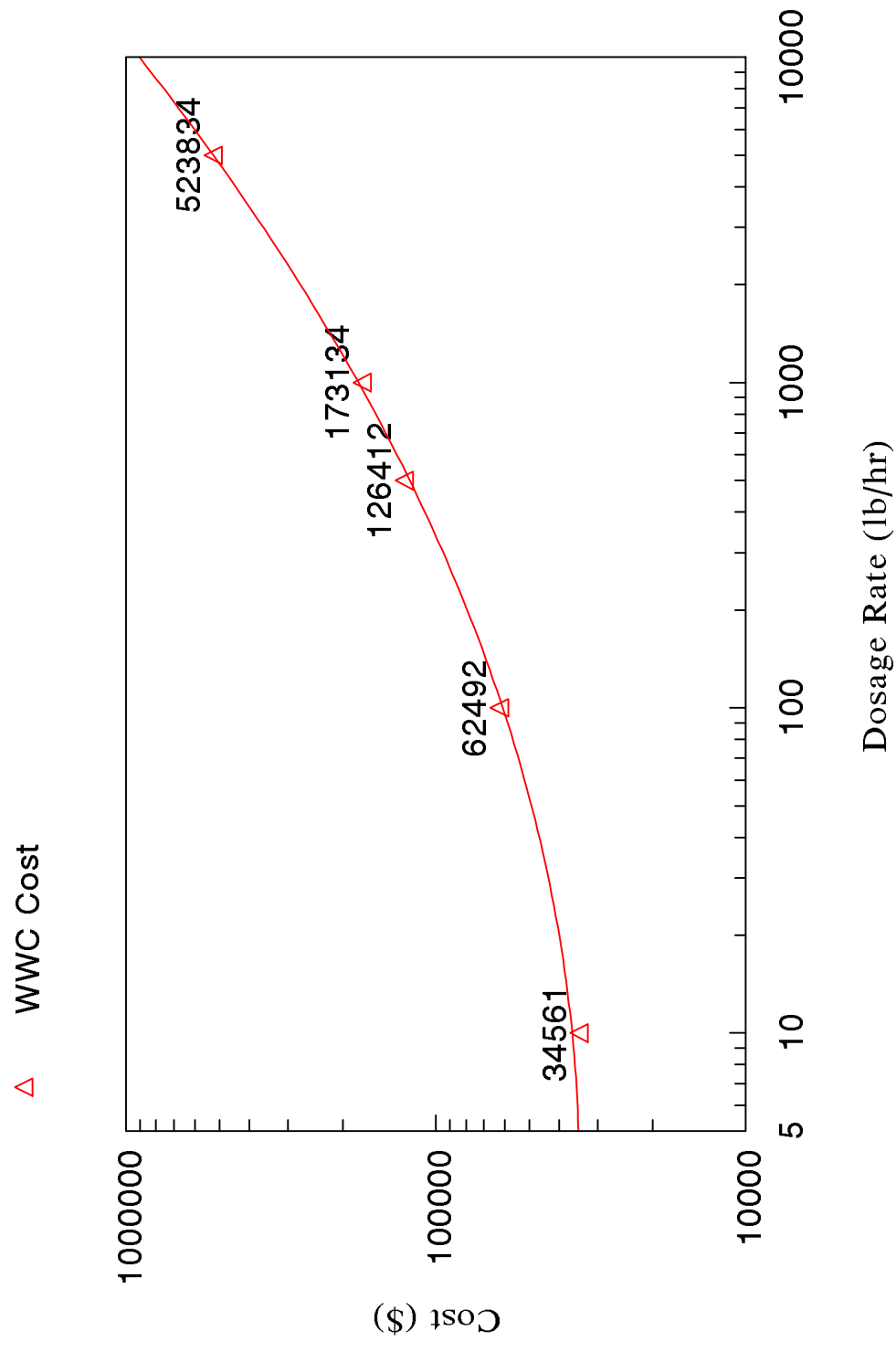


Figure 9-10
Polymer Feed O&M Cost Curve

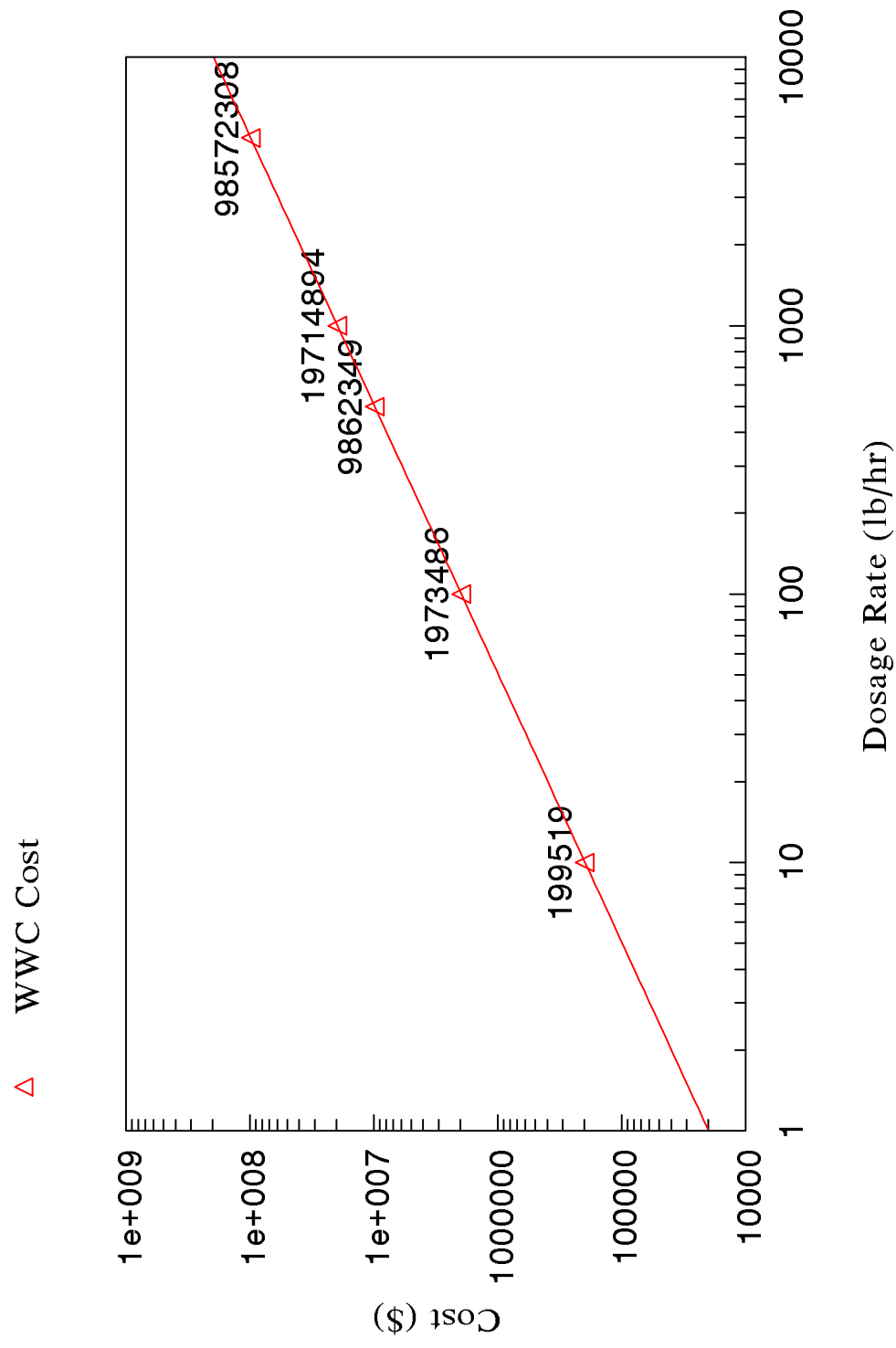


Figure 9-11
Primary Clarifier Capital Cost Curve

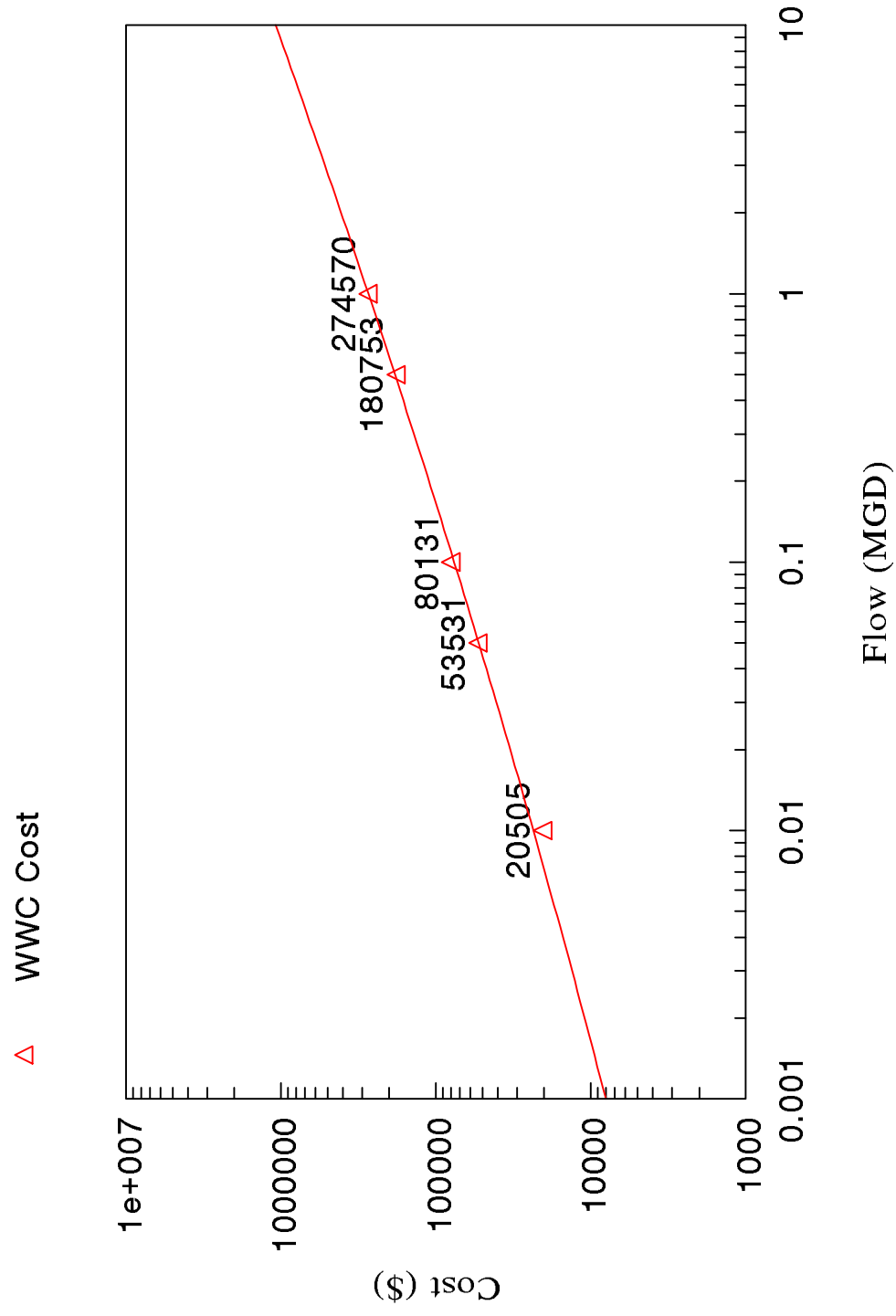


Figure 9-12
Primary Clarifier O&M Cost Curve

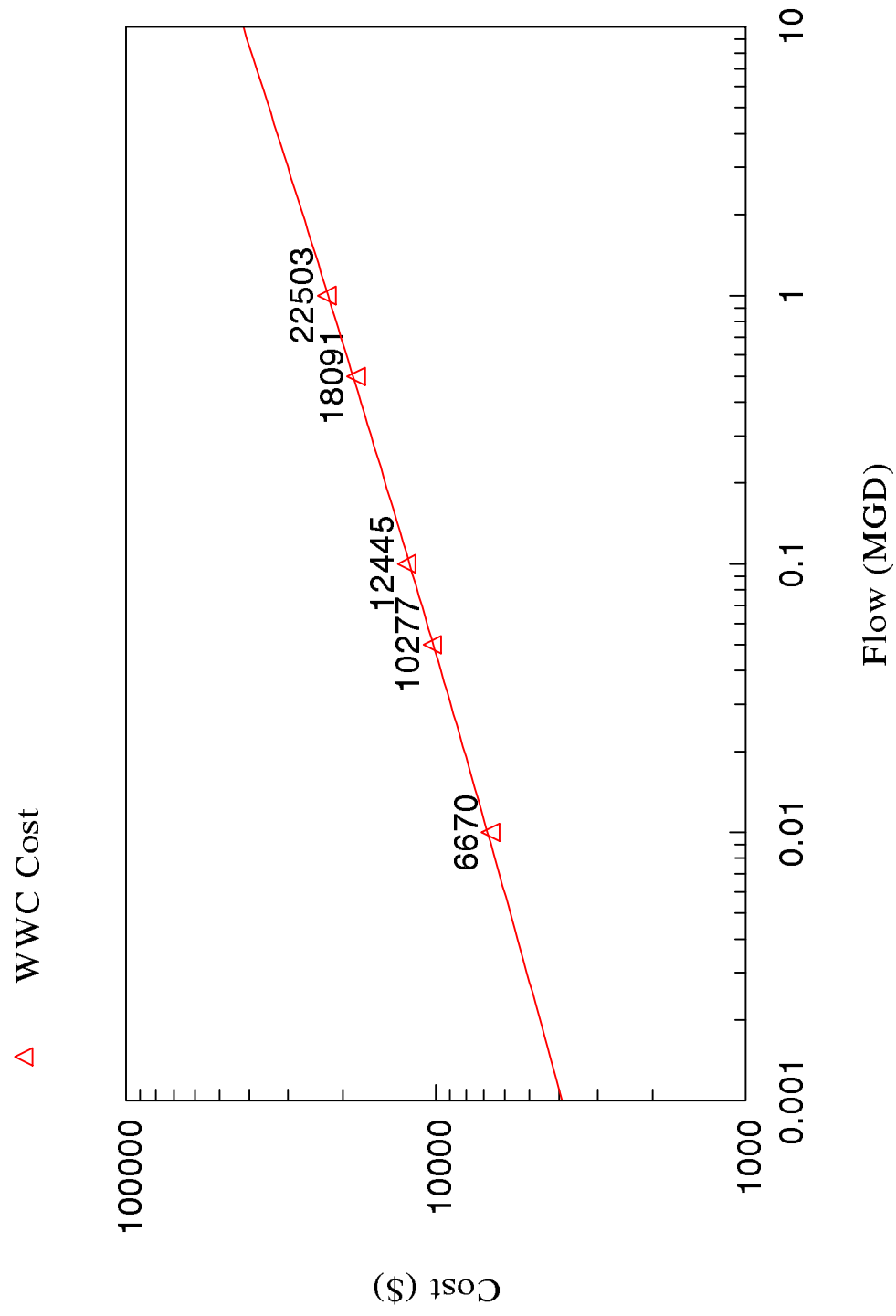


Figure 9-13
Aeration Basin Capital Cost Curve

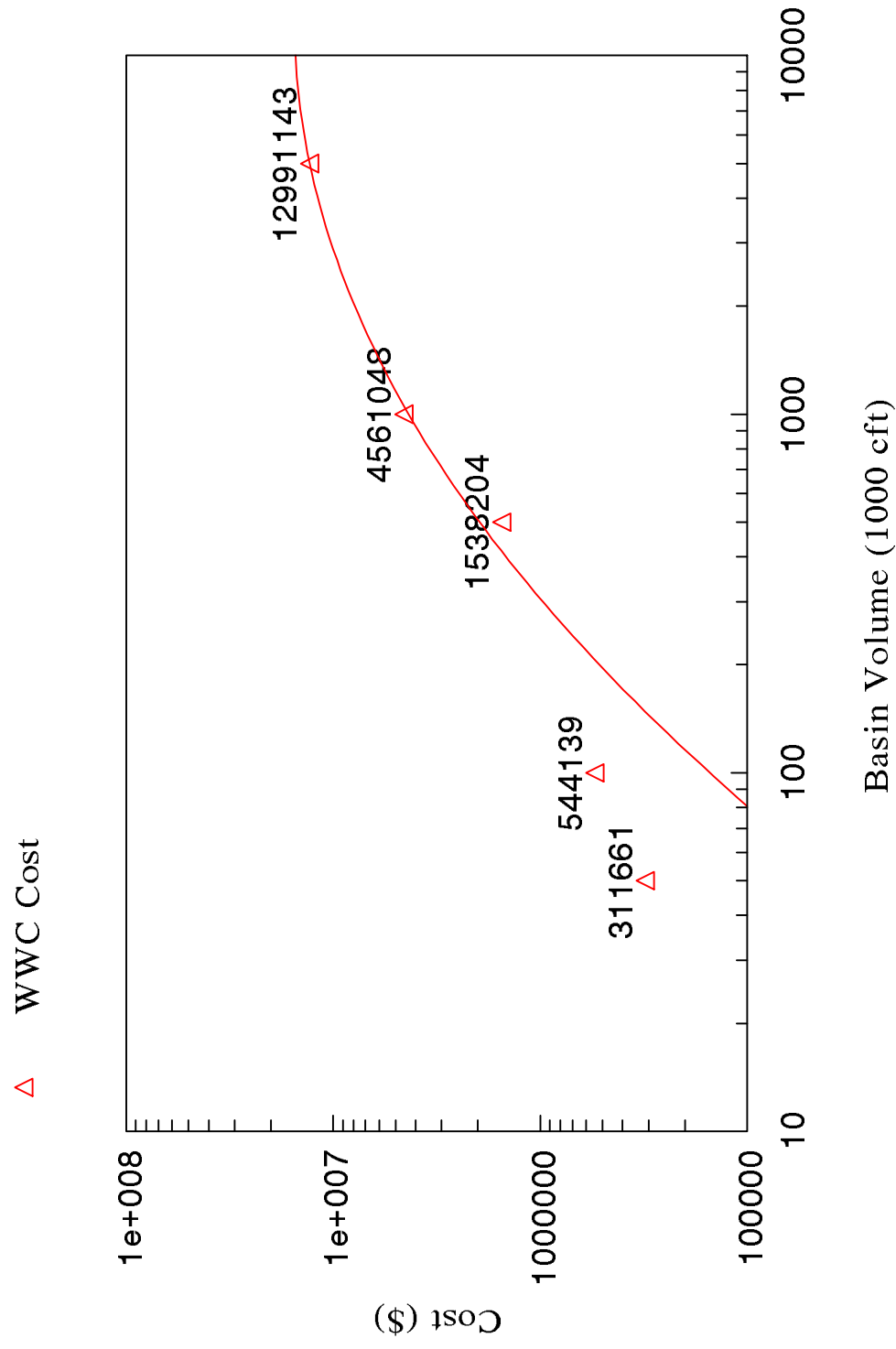


Figure 9-14
Air Diffusion System Capital Cost Curve

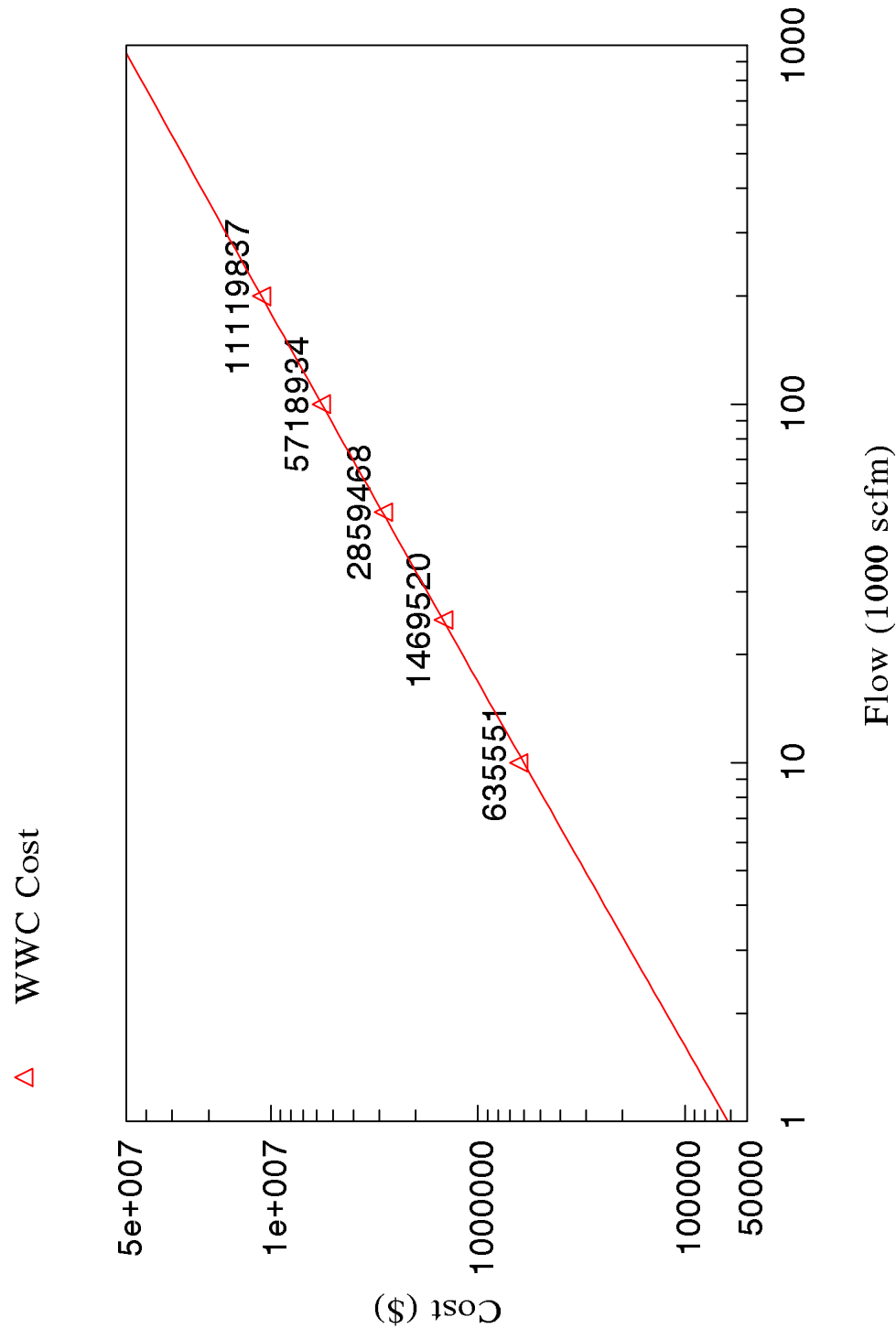


Figure 9-15
Air Diffusion System O&M Cost Curve

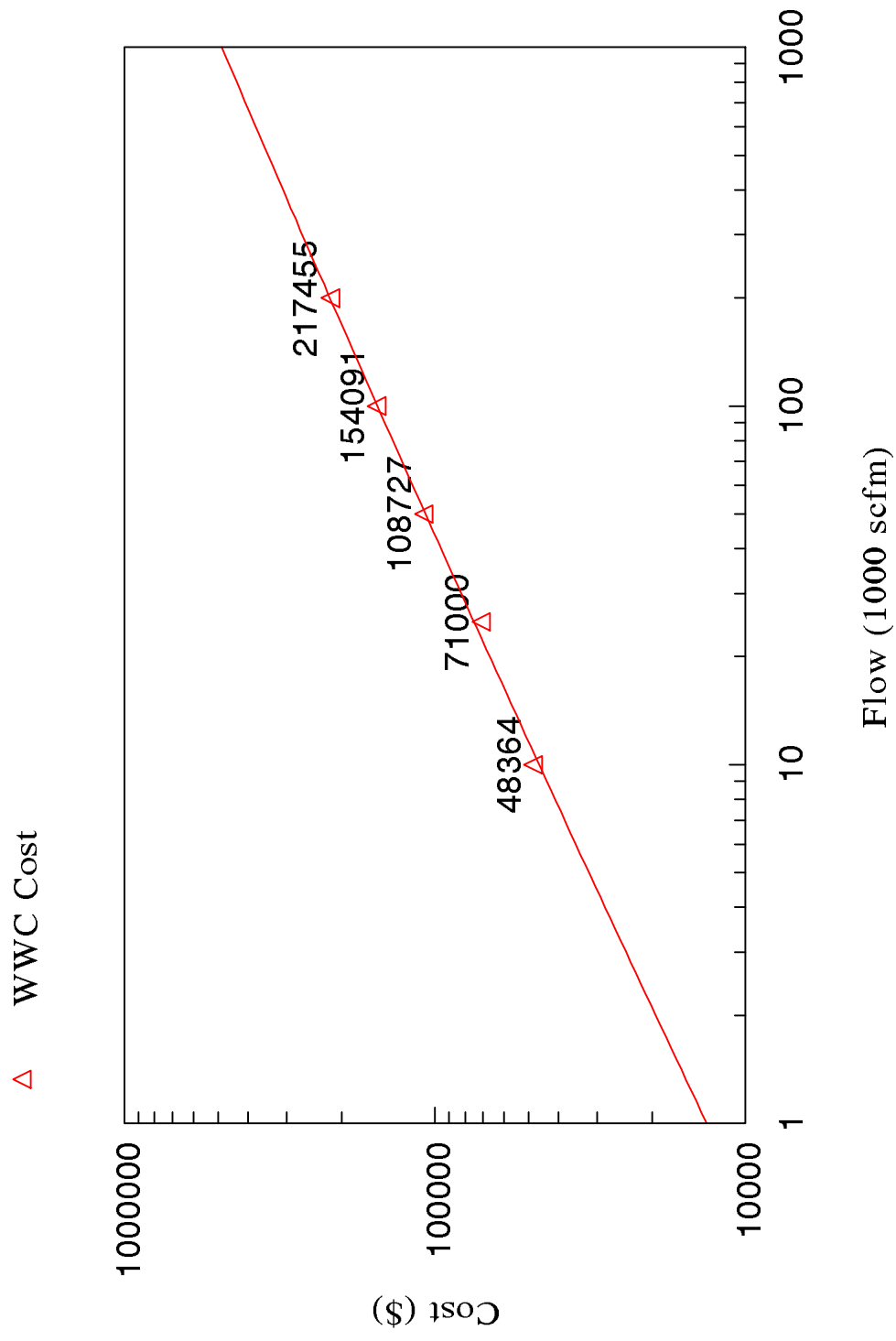


Figure 9-16
Secondary Clarifier Capital Cost Curve

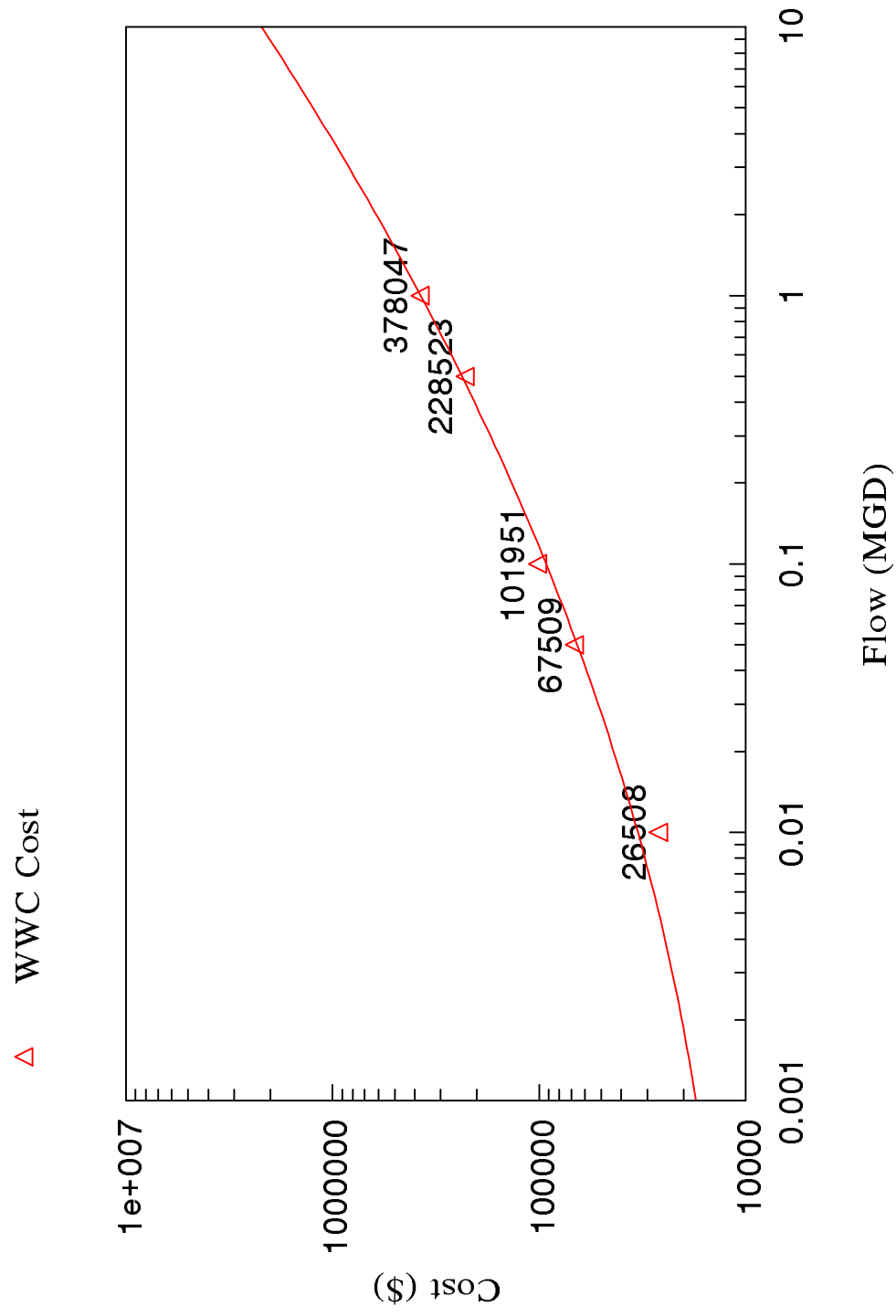


Figure 9-17
Secondary Clarifier O&M Cost Curve

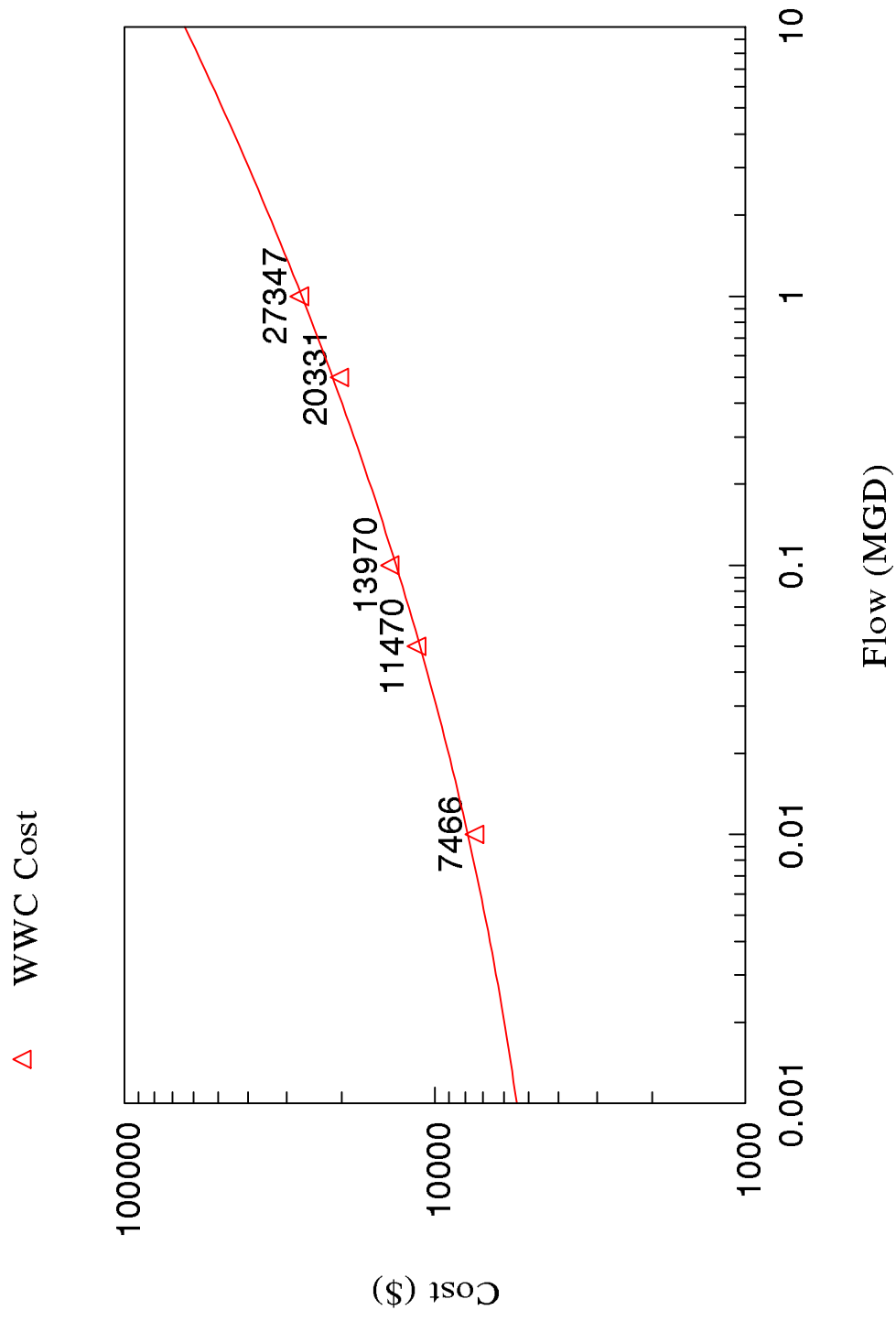


Figure 9-18
Multimedia Filtration Capital Cost Curve

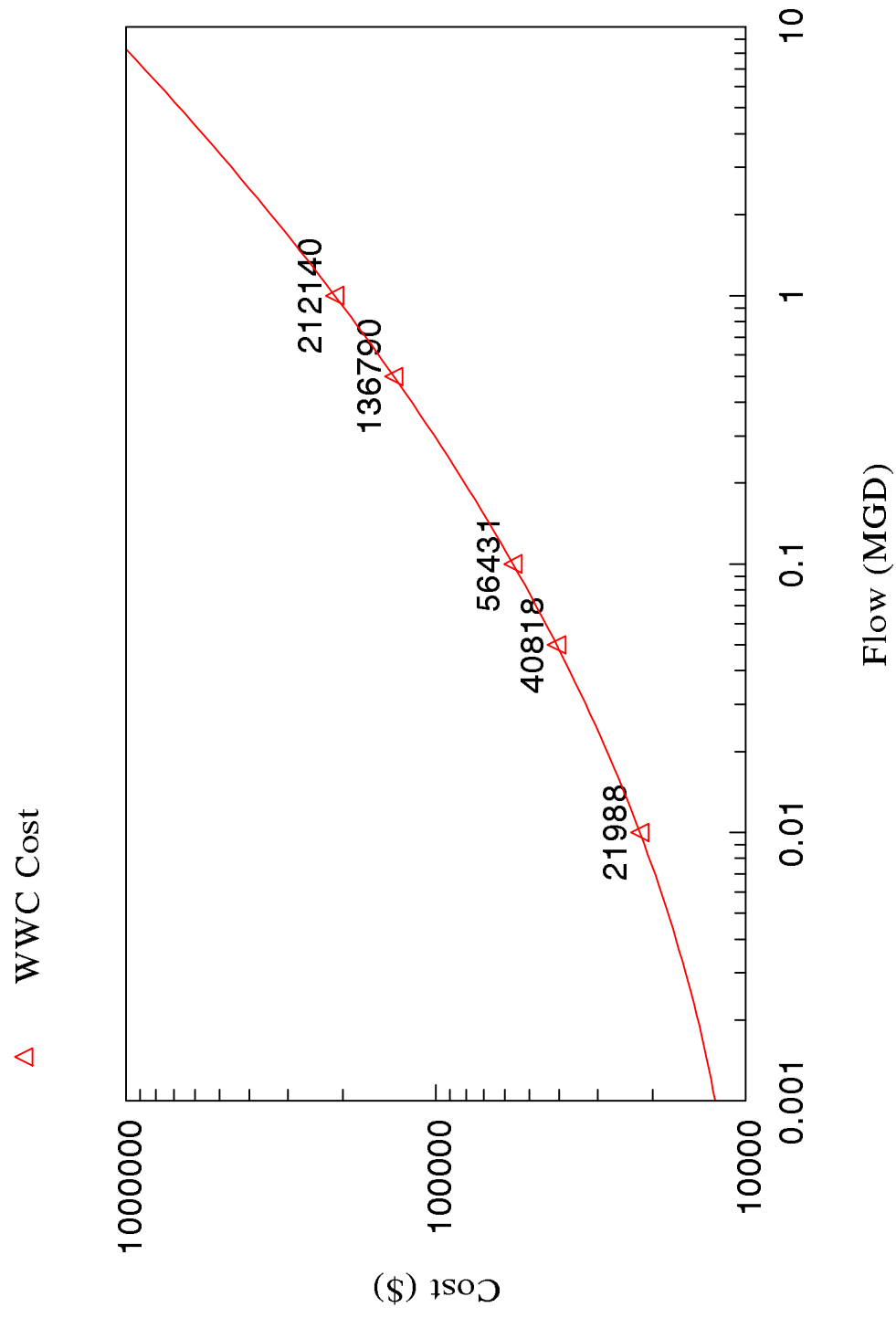


Figure 9-19
Multimedia Filtration O&M Cost Curve

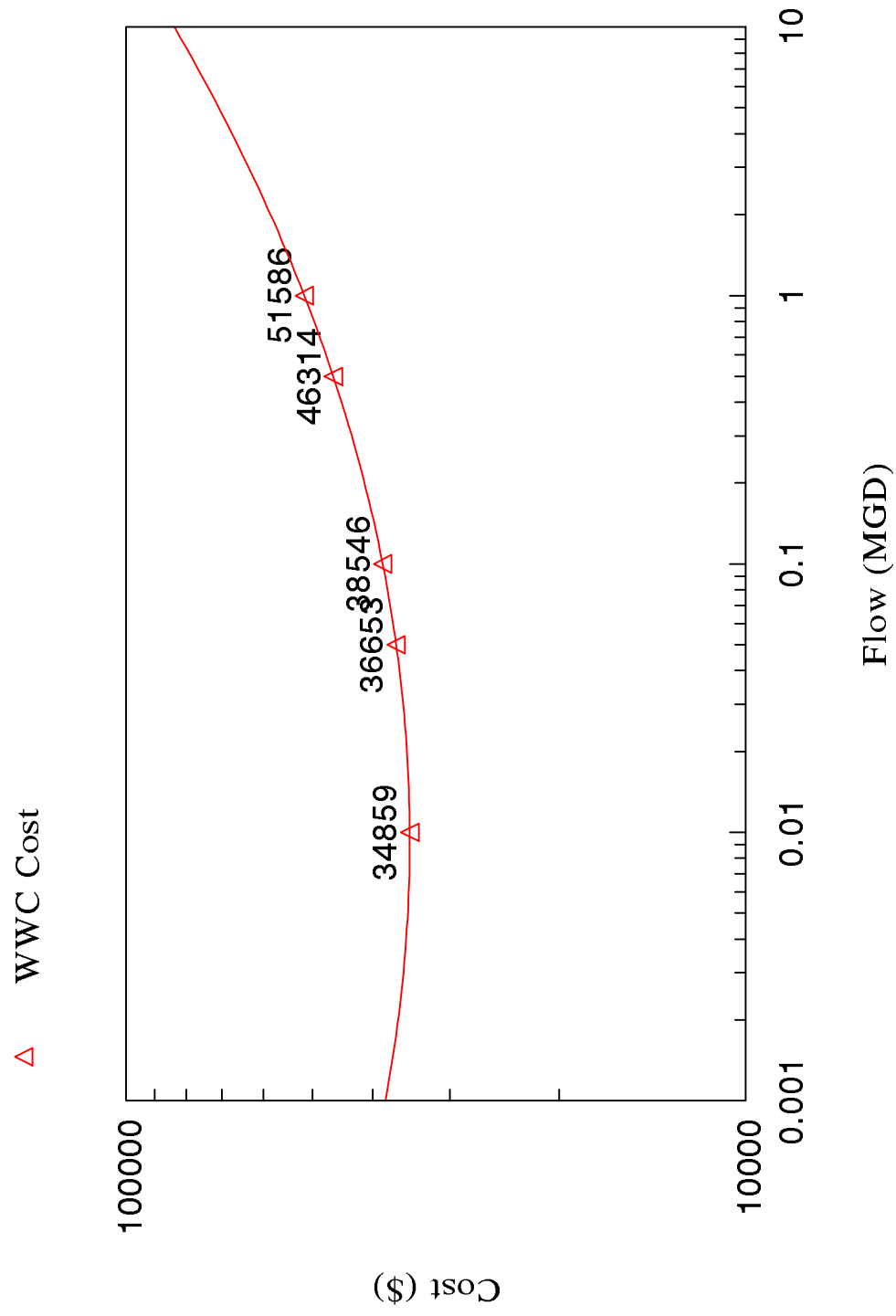


Figure 9-20
Reverse Osmosis Capital Cost Curve

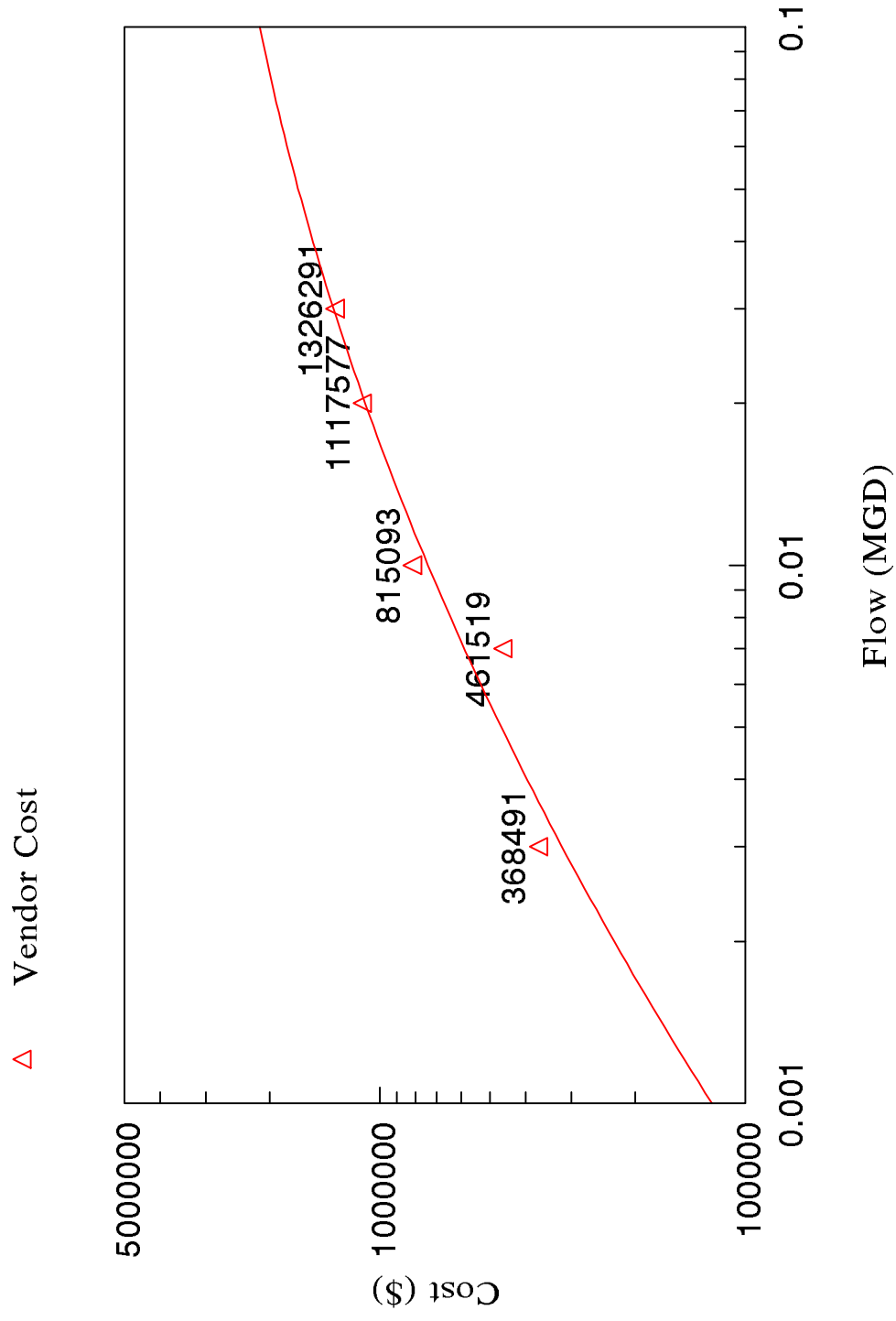


Figure 9-21
Sludge Drying Beds Capital Cost Curve

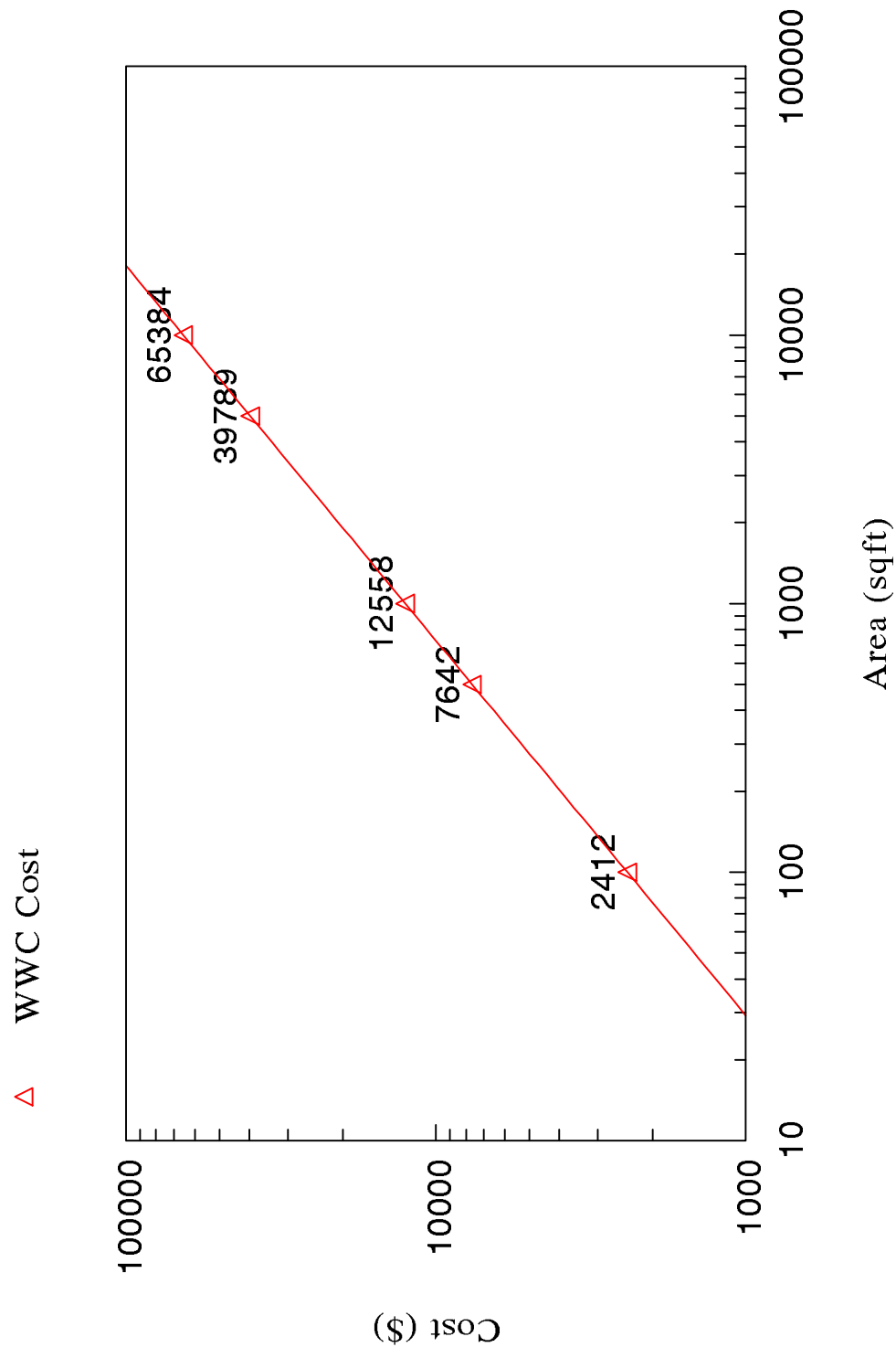
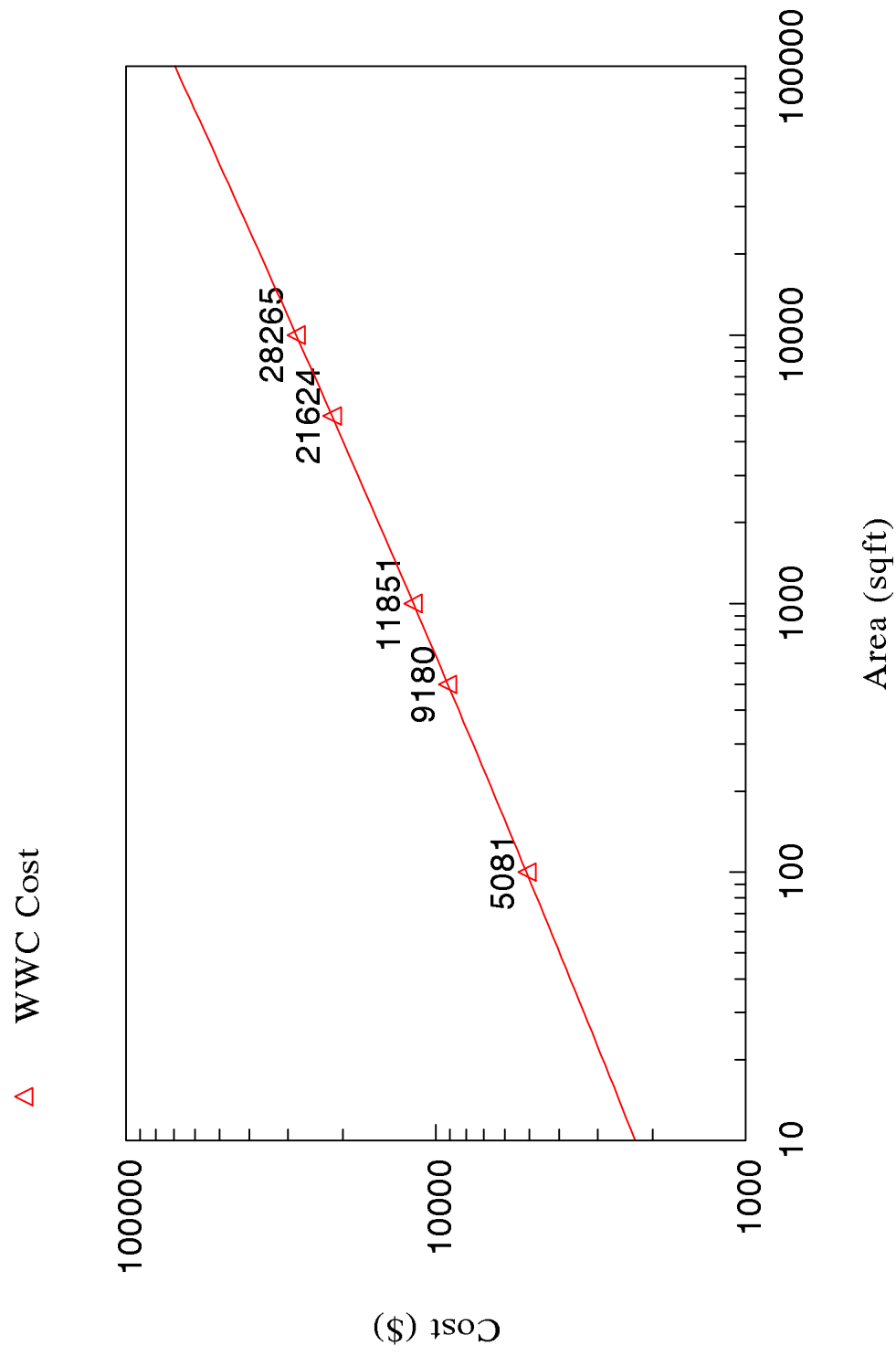


Figure 9-22
Sludge Drying Beds O&M Cost Curve



10.0 NON-WATER QUALITY IMPACTS

The operation of wastewater treatment systems has the potential for causing an environmental impact through the generation of solid and hazardous residuals, air emissions, and the energy consumption of the wastewater treatment equipment.

The elimination or reduction of one form of pollution may create or aggravate other environmental problems. Therefore, Sections 304(b) and 306 of the Clean Water Act (CWA) require EPA to consider the non-water quality environmental impacts and energy requirements of effluent limitations guidelines and standards. Pursuant to these requirements, EPA has considered the effect of promulgating the proposed BPT, BCT, BAT, NSPS, PSES and PSNS regulations for the Landfills industry in regard to the creation of additional air pollution, solid and hazardous waste, and energy consumption.

While it is difficult to balance environmental impacts across all media and energy use, the Agency determined that the impacts identified below do not outweigh the benefits associated with compliance with the limitations and standards.

10.1 Air Pollution

The primary source of air pollution from landfills is due to the microbial breakdown of organic wastes from within the landfill. Landfills are known to be major sources of greenhouse gas emissions such as methane and carbon dioxide. These emissions are now regulated under the Clean Air Act (CAA) as a result of the municipal solid waste landfill Standards of Performance for New Stationary Sources and Guidelines for Control of Existing Sources, promulgated by the EPA on March 12, 1996 (Federal Register: Volume 61, Number 49) and codified in 40 CFR 60 Subpart CC-Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills and Subpart WWW-Standards of Performance for Municipal Solid Waste Landfills. In accordance with these regulations, many non-hazardous solid waste landfills are required to install systems to collect gases generated in the landfill.

Wastewater collected from within the landfill contains organic compounds which include volatile organic compounds and hazardous air pollutants. These wastewaters must be collected, treated, and stored in units which are often open to the atmosphere and will result in the volatilization of certain compounds. Organic pollutants volatilize in reaching an equilibrium with the vapor phase above the wastewater. These volatile organic compounds are emitted to the ambient air surrounding the collection and treatment units. The magnitude of volatile organic compound emissions is dependent on factors such as the physical properties of the pollutants, the temperature of the wastewater, and the design of the individual collection and treatment units. The proposed regulations for the Landfills industry were based on the use of an aerated biological system. Wastewater aeration may increase the volatilization of certain organic compounds. However, the increase in air emissions due to this proposed regulation will be minimal and will not significantly increase the air emissions from landfills. Chapter 6 of this development document, which discusses raw wastewater characterization, describes the relatively small amount of volatile organic compounds currently found in untreated landfill wastewaters (see Table 6-11).

In addition, EPA is addressing emissions of volatile organic compounds from industrial wastewater through a Control Techniques Guideline (CTG) under Section 110 of the Clean Air Act. CAA amendments require that State implementation plans for certain ozone nonattainment areas be revised to require the implementation of reasonably available control technology (RACT) for control of volatile organic compound emissions from sources for which EPA has prepared CTGs. In September, 1992, EPA published a draft CTG document entitled "Control of Volatile Organic Compound Emissions from Industrial Wastewater". This document addresses various industries, including the hazardous waste treatment, storage, and disposal facilities (TSDF) industry, and outlines volatile organic compound emissions expected from their wastewater treatment systems and methods for controlling them. For CTG guideline purposes, EPA has included Subtitle C and D landfills with leachate collection systems in the TSDF industry. EPA estimates that nearly all landfills affected by the Landfills effluent guideline will be subject to this CTG for their volatile emissions from their wastewater treatment systems. It was estimated in the CTG draft document that 43 percent of the facilities in the TSDF industry are located in areas of ozone nonattainment. In 1994, the draft CTGs

were revised to reflect changes that were made in the wastewater provisions of the Hazardous Organic National Emission Standards for Hazardous Air Pollutants promulgated by the EPA on April 22, 1994 (Federal Register: Volume 59, Number 19). EPA published these changes to the CTGs in a document entitled “Industrial Wastewater Alternative Control Technology”.

10.2 Solid and Other Aqueous Waste

Solid and other aqueous waste would be generated by several of the wastewater treatment technologies expected to be implemented to comply with the landfills regulation. The costs for the disposal of these other waste residuals were included in the compliance cost estimates prepared for the regulatory options. Solid wastes generated by a number of the proposed BPT, BCT, BAT, and PSES wastewater treatment technologies include sludge from clarifiers associated with biological treatment and chemical precipitation systems and backwash waters from filtration systems.

In surveying both subcategories of this industry, EPA determined that it is common practice to dispose of the sludges generated by the on-site wastewater treatment systems directly back into the landfills. This practice eliminates the need for, and the costs associated with, off-site disposal. Analysis of sludge data collected as part of this study also indicates that sludges generated by wastewater treatment systems at landfills in the Subtitle D Non-Hazardous subcategory are non-hazardous, allowing them to be disposed of at the landfill sites from which they are generated.

Waste sludge generated by wastewater treatment facilities at landfills in the Subtitle C Hazardous subcategory may or may not be a hazardous waste, depending upon factors such as the characteristics of the waste deposited in the landfill and the design and operation of the wastewater treatment system. If listed hazardous wastes as per 40 CFR 261 Subpart D are disposed of into the landfill, the resultant sludges from the treatment of landfill generated wastewaters will be considered a hazardous waste. Based upon the “derived-from” rule found in 40 CFR 261.3(c)(2), the sludge will have the same RCRA waste code as the waste in the landfill for monofills. For hazardous waste landfills which dispose of more than one type of listed hazardous waste and generate a multi-source leachate, the sludge from treatment of the leachate will have the F039 RCRA waste code. Sludges from a treated

leachate at a landfill which handles only characteristic wastes as per 40 CFR 261 Subpart C will need to be analyzed for to determine whether it exhibits any of the characteristics of a hazardous waste as per 40 CFR 261 Subpart C. EPA has developed land disposal restrictions as found in 40 CFR 268. This regulation places restrictions on the land disposal of wastes and specifies treatment standards that must be met before wastes can be land disposed. For purposes of this regulation, EPA has assumed that dried sludges from facilities in the Subtitle C Hazardous subcategory will be returned to the on-site landfill for disposal. Similarly, EPA has assumed dried sludges from Subtitle D non-hazardous facilities will be returned to the on-site landfill for disposal. Listed or characteristically hazardous waste sludges are to meet applicable treatment standards prior to disposal.

The increased amount of sludge created due to this regulation will be negligible in comparison with the daily volumes of waste processed and disposed in a typical landfill, whether non-hazardous or hazardous. As a result, the practice of on-site disposal has a minimal impact on landfill capacity. For example, based on national estimates the Subtitle D Non-Hazardous subcategory processed approximately 5,300 million tons of waste in 1992. The BPT/BCT/BAT/PSES wastewater treatment options will generate approximately 0.0044 million tons per year of waste solids or only 8.3×10^{-5} percent of the volume of waste disposed into the landfill. For the Subtitle C Hazardous subcategory, the BPT/BCT/BAT/PSES option will generate approximately 194 tons per year of solids as compared to the national estimate of 550 million tons of waste processed, which equates to 3.5×10^{-5} percent.

Filtration backwash waters are generally recycled to the beginning of the wastewater treatment system for reprocessing. This practice eliminates the generation of a waste stream needing disposal.

10.3 Energy Requirements

The operation of wastewater treatment equipment results in the consumption of energy. EPA estimates that the attainment of the proposed BPT, BCT, BAT, or PSES standards will increase energy consumption by a very small increment over present industry use. The treatment technologies that are the basis for the proposed limitations and standards are not energy-intensive, and the projected increase in energy consumption is primarily due to the incorporation of components such

as power pumps, mixers, blowers, power lighting and controls, and heating devices. The costs associated with these energy costs are included in EPA's estimated operating costs for compliance with the proposed guideline presented in Chapter 9. For example, the BPT/BCT/BAT Option 2 for the Subtitle D Non-Hazardous subcategory is estimated to consume 3,300 megawatt-hour per year (Mwhr/year). This is equivalent to approximately 1,800 barrels per year of No.2 fuel oil, as compared to the 1992 rate of consumption in the United States of 40.6 million barrels per year. The additional energy demand imposed by this regulatory option will represent an insignificant increase in the production or importation of fuel oil. For the Subtitle C Hazardous subcategory, the proposed regulatory option is estimated to consume 37.3 Mwhr/yr or an equivalent 21 barrels per year of No.2 fuel oil.